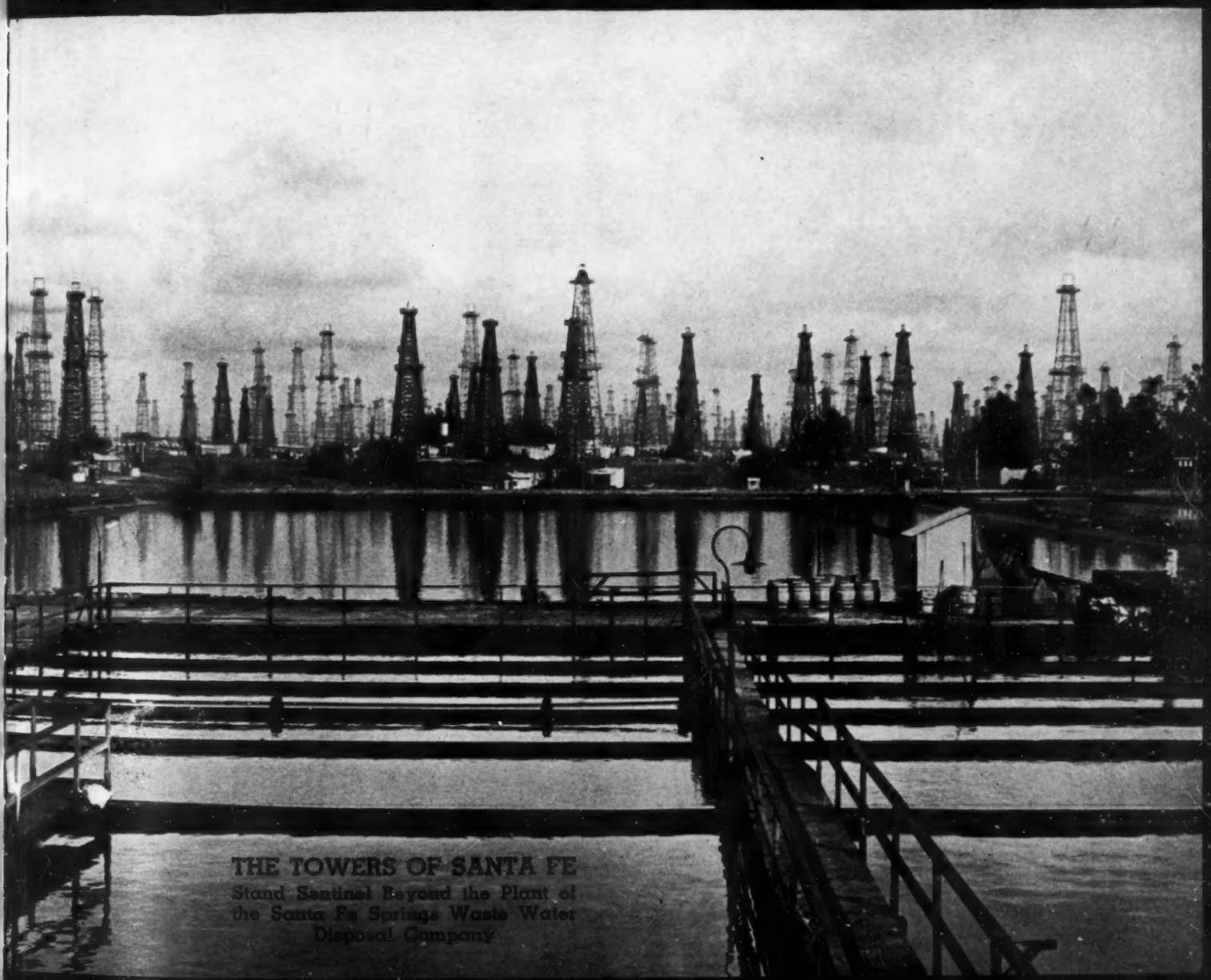
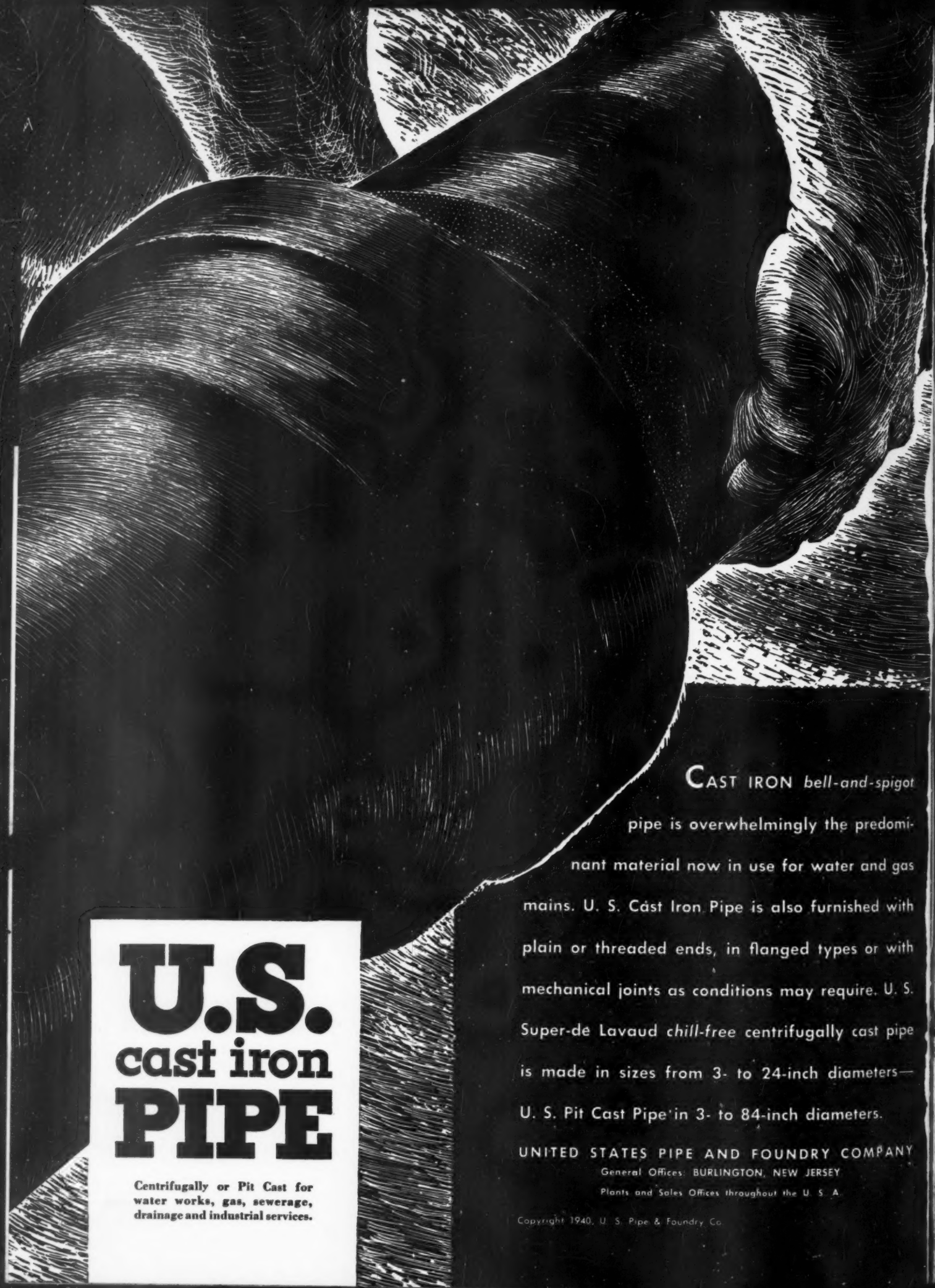
WATER WORKS & SEWERAGE

ABC



THE TOWERS OF SANTA FE
Stand Sentinel Beyond the Plant of the Santa Fe Springs Waste Water Disposal Company



U.S. cast iron PIPE

Centrifugally or Pit Cast for water works, gas, sewerage, drainage and industrial services.

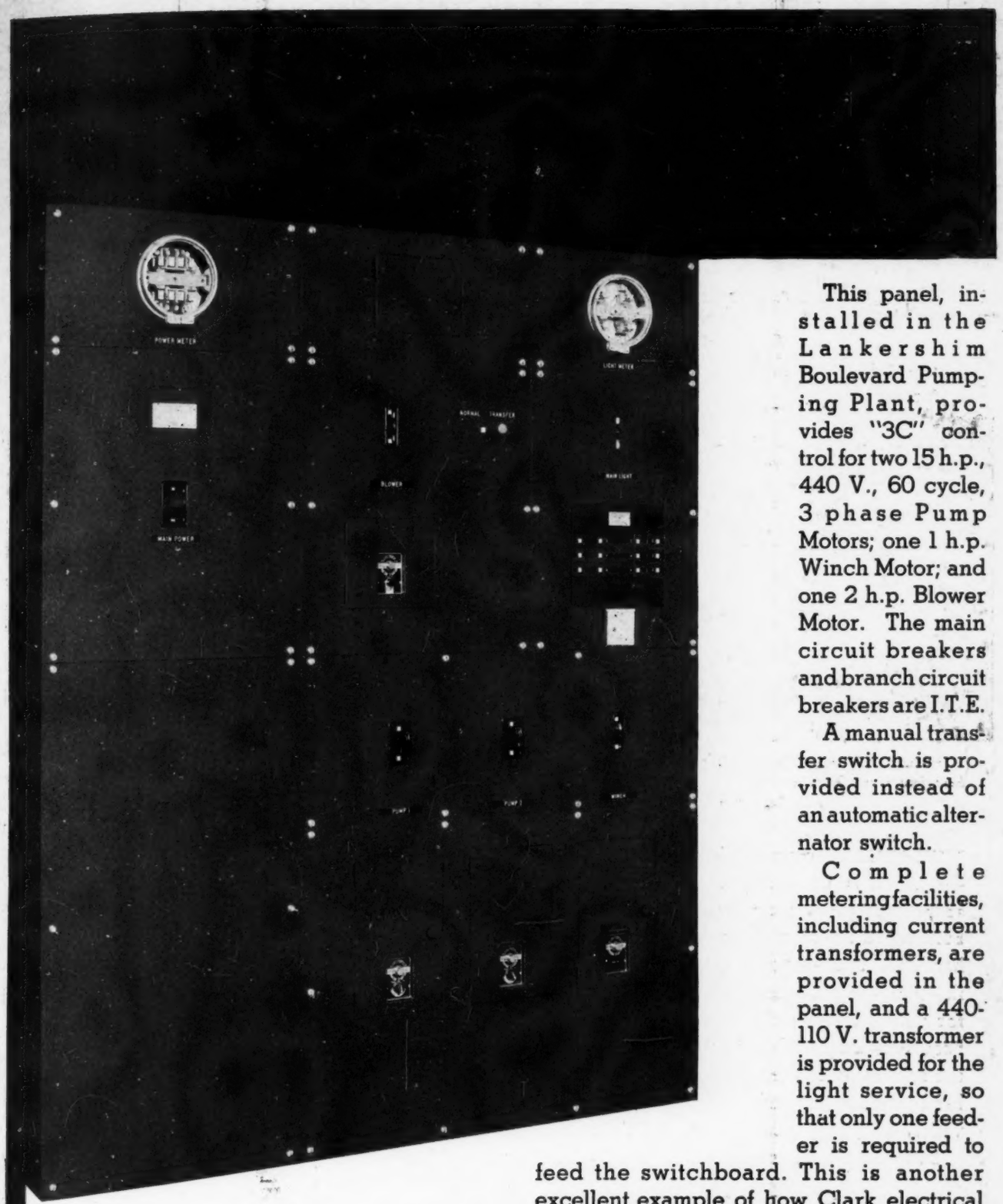
CAST IRON *bell-and-spigot* pipe is overwhelmingly the predominant material now in use for water and gas mains. U. S. Cast Iron Pipe is also furnished with plain or threaded ends, in flanged types or with mechanical joints as conditions may require. U. S. Super-de Lavaud *chill-free* centrifugally cast pipe is made in sizes from 3- to 24-inch diameters—U. S. Pit Cast Pipe in 3- to 84-inch diameters.

UNITED STATES PIPE AND FOUNDRY COMPANY

General Offices: BURLINGTON, NEW JERSEY

Plants and Sales Offices throughout the U. S. A.

Copyright 1940, U. S. Pipe & Foundry Co.



This panel, installed in the Lankershim Boulevard Pumping Plant, provides "3C" control for two 15 h.p., 440 V., 60 cycle, 3 phase Pump Motors; one 1 h.p. Winch Motor; and one 2 h.p. Blower Motor. The main circuit breakers and branch circuit breakers are I.T.E.

A manual transfer switch is provided instead of an automatic alternator switch.

Complete metering facilities, including current transformers, are provided in the panel, and a 440-110 V. transformer is provided for the light service, so that only one feeder is required to feed the switchboard. This is another excellent example of how Clark electrical control apparatus helps safeguard health and property.

OFFICES IN PRINCIPAL CITIES

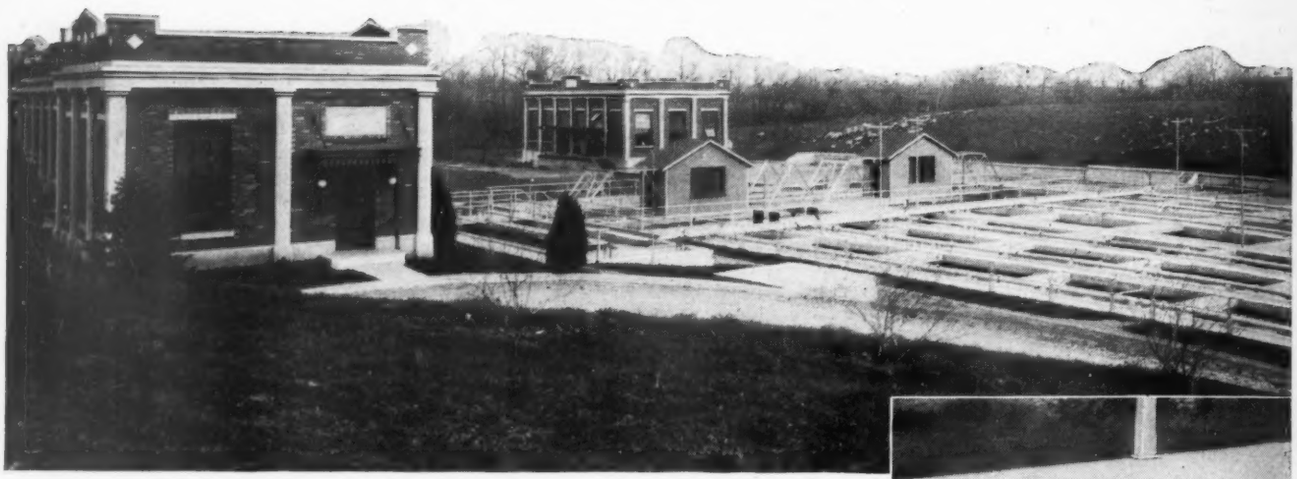
THE CLARK CONTROLLER CO.

1146 EAST 152ND ST. CLEVELAND, OHIO

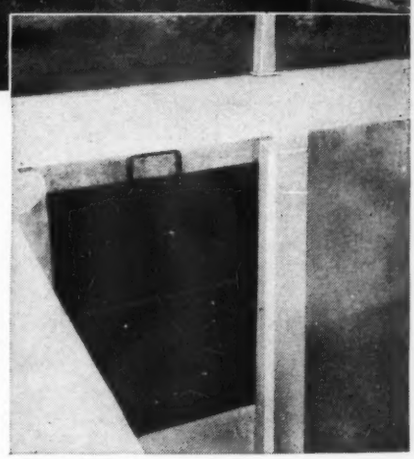
WATER WORKS & SEWERAGE, August, 1940. Volume 87. Number 8. Published monthly at 330 South Wells Street, Chicago, Ill., by the Gillette Publishing Company. Per copy, 25c. Subscription rate, United States $2.00 per year; Canada $2.40 per year; Foreign $3.00 per year. Copyright, 1940. Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under Act of March 3, 1879.

What Alloy for Gates in AERATION CHAMBERS?

Engineers for Hagerstown plant, like many others, find Everdur ideal, for it is strong and highly resistant to corrosion



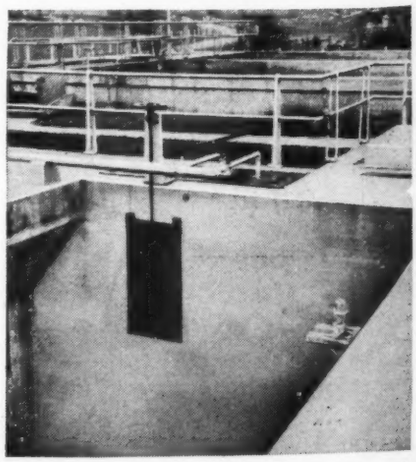
Hagerstown, Md., Sewage Disposal Plant where 14 Everdur gates and one Everdur weir plate have given expense-free service since 1932. Fuller & McClintock, N. Y., Consulting Engineers. *J. B. Ferguson & Co., Hagerstown,* Contractors.



Hand- and stem-operated gates at the Hagerstown, Md., Sewage Disposal Plant.

EVERDUR, a copper-silicon alloy, is unusually well adapted to lightweight, wrought built up structures such as the hand- and stem-operated gates illustrated. It has been selected for a large number of projects because over a period of 13 years the superiority of the alloy has been demonstrated under a wide variety of operating conditions.

EVERDUR is rustproof and highly resistant to corrosion, possesses great strength and can be fabricated economically by all common methods. What's more, this valuable alloy is moderate in cost. A more complete explanation of its wide use, not only for gates but also screens, effluent and scum weirs, etc., will be found in Anaconda Publication E-11. Write for a copy—there's no obligation. 40136



ANACONDA

Visit the Copper & Brass Industry Exhibit in the Hall of Industry, New York World's Fair—1940

© N.Y.W.F.

Everdur Metal

EVERDUR is a trade-mark of The American Brass Co., registered in the United States Patent Office.

THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Connecticut

In Canada: Anaconda American Brass Ltd., New Toronto, Ont. • Subsidiary of Anaconda Copper Mining Co.

How One Water Works Actually Saved 47%

• Original Cost of Chemicals (per million gal.) $4.41

• Cost using Standard Silicate (per million gal.) $2.34

Source of Water Supply—Surface water from nearby creeks collected in reservoir holding six months' supply.

Daily capacity—Five Million Gallons.

Average Turbidity—30-50 **pH**—7.7

Dosage before using Standard Silicate—2 grains alum per gallon.

Cost—$4.41 per million gallons using alum alone.

Dosage after using Standard Silicate—1 gr./gal. alum. and .3 gr./gal. Standard Silicate.

Cost—$2.34 per million gallons, using alum plus silicate.

SAVING—$2.07 or 47%.

In addition to the lower cost, larger flocs and longer filter runs were obtained. This is not an unusual record. It represents the savings possible through the use of Standard Silicate in your plant. Why not fill out the coupon below and we will gladly send you further information.

DIAMOND ALKALI COMPANY • Standard Silicate Division

Plants at CINCINNATI · JERSEY CITY
LOCKPORT, N.Y. MARSEILLES, ILL.

General Offices • PITTSBURGH, PA.

TEAR OFF AND MAIL

Standard Silicate Division, Diamond Alkali Company, Oliver Building, Pittsburgh, Pa.

Our water supply has the following characteristics:

.....**Million Gallons per Day** **Average Turbidity** ..... **Present Dosage**....**gr./gal.** **Coagulant**.....

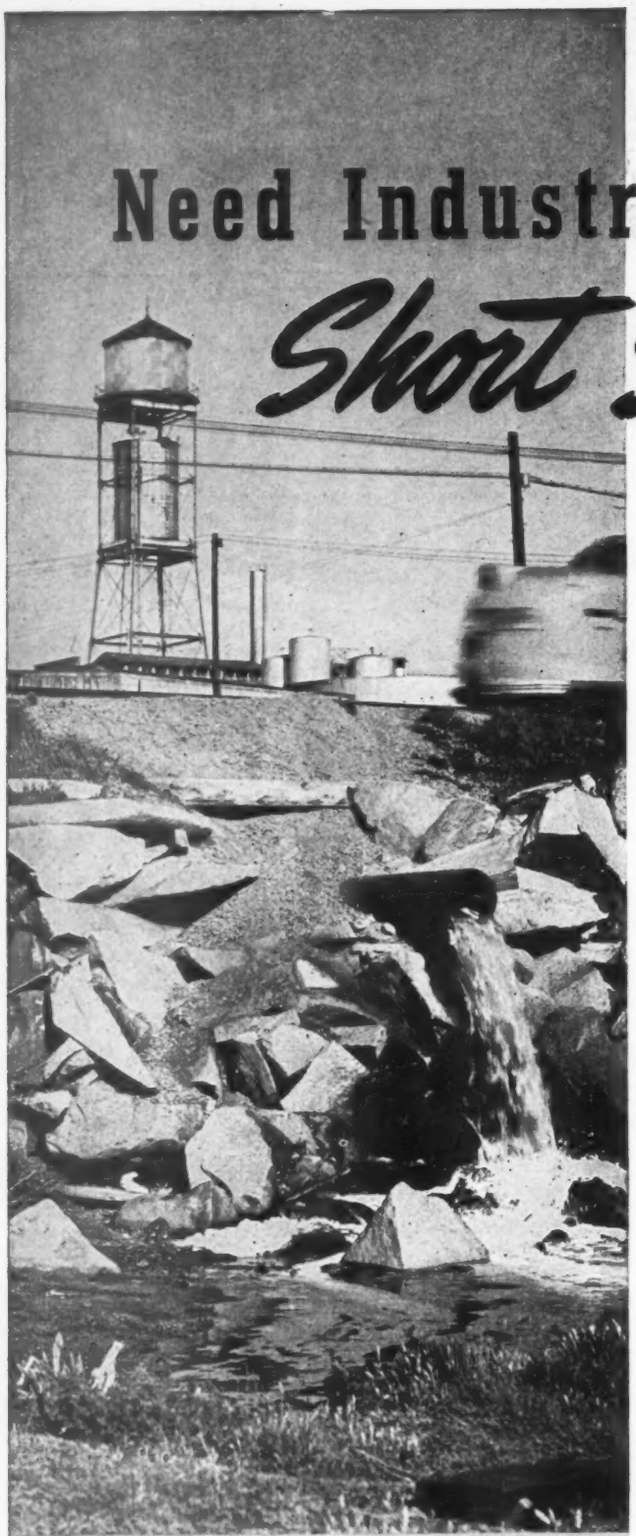
We would be glad to receive further information on the use of Standard Silicate.

Name..... **Title**.....

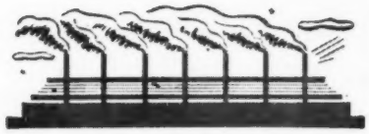
Water Works .....**City**.....**State**.....

W-3

Need Industrial Waste Cause *Short Sewer Life?*



Installed under a main line railroad near the seacoast, this ARMCO Asbestos-Bonded Pipe discharges corrosive waste from a large industrial plant. A stern test of material durability and structural strength.



It's true that sewer materials often fail quickly when handling industrial wastes. Yet there *is* a way to extend sewer life under these conditions. A special bituminous coating has proved excellent protection against corrosion. The only problem was how to obtain positive adhesion between coating and sewer.

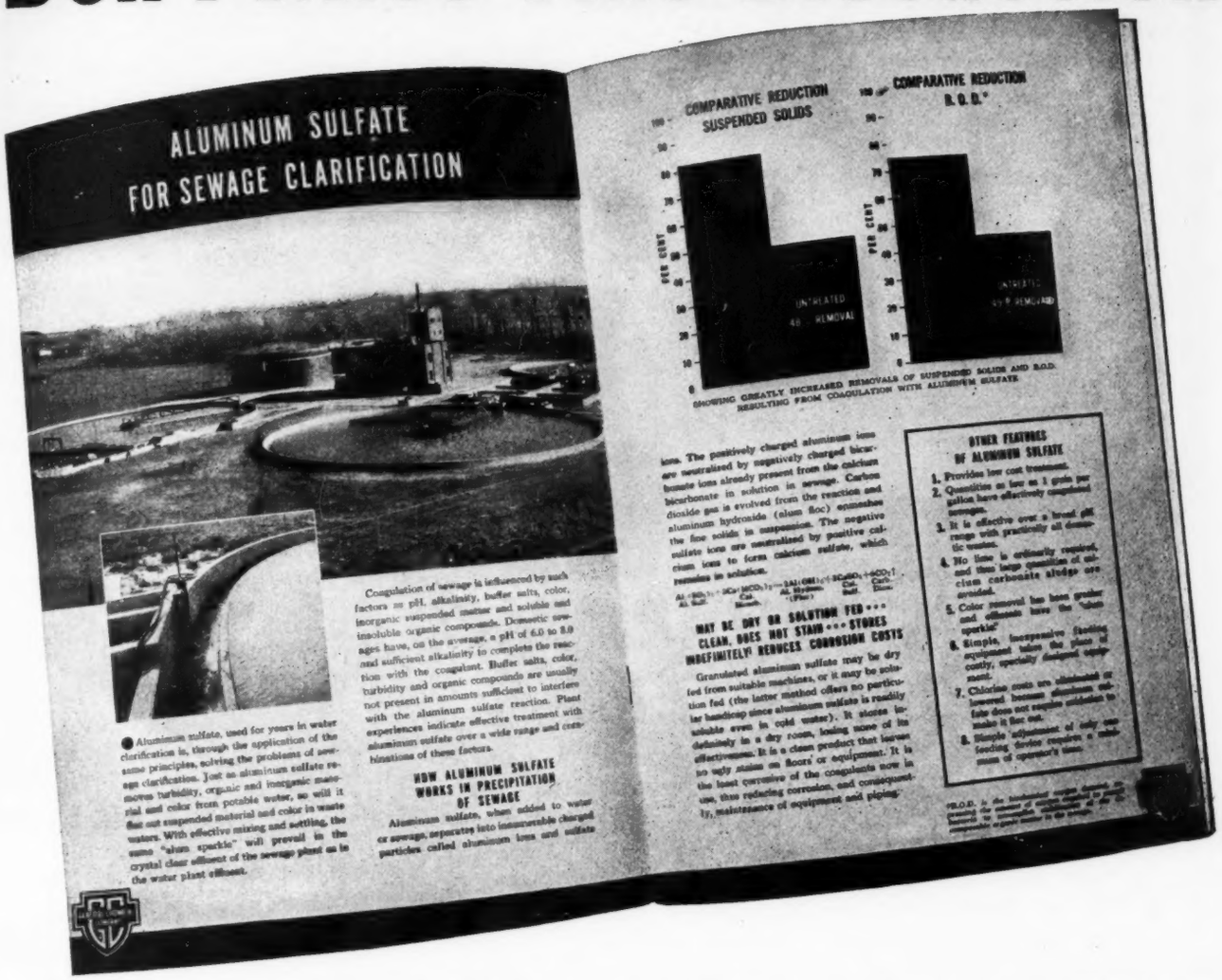
After years of research ARMCO engineers found the answer in an asbestos-bonding process. A layer of asbestos felt is used to permanently bind the full bituminous coating to the galvanized pipe. This acid-resisting coating on ARMCO Sewer Pipe assures complete protection against corrosion. And a thick, smooth pavement of the same material safeguards the bottom from erosion. ARMCO Pipe also has the advantage of great structural strength, derived from its flexible, corrugated design—proved in more than 34 years of service.

Thus you can readily see why ARMCO Asbestos-Bonded Sewer Pipe lasts longer and costs less to maintain even in the severest service. And since ARMCO Pipe can solve your *worst* sewer problems, naturally it will be that much more durable under ordinary conditions. Try ARMCO Asbestos-Bonded Pipe on your next sewer project. You'll be repaid by years of useful, unfailing service. Why not write us about your potential needs or see the local ARMCO man. ARMCO DRAINAGE PRODUCTS ASSOCIATION, 5045 Curtis Street, Middletown, Ohio.

ARMCO ASBESTOS-BONDED PIPE

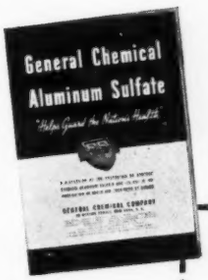
ORIGINATED AND DEVELOPED BY ARMCO ENGINEERS

Don't Miss This Discussion


ALUMINUM SULFATE
FOR SEWAGE CLARIFICATION
COMPARATIVE REDUCTION
SUSPENDED SOLIDS
COMPARATIVE REDUCTION
B.O.D.*
PER CENT
UNTREATED
48% REMOVAL
SHOWING GREATLY INCREASED REMOVALS OF SUSPENDED SOLIDS AND B.O.D. RESULTING FROM COAGULATION WITH ALUMINUM SULFATE
OTHER FEATURES
OF ALUMINUM SULFATE
1. Provides low cost treatment.
2. Quantities as low as 1 grain per gallon have effectively coagulated sewages.
3. It is effective over a broad pH range with practically all domestic wastes.
4. No lime is ordinarily required, and then large quantities of calcium carbonate sludge are avoided.
5. Color removal has been greater and effluents have the "clear and sparkle"
6. Simple, inexpensive feeding equipment takes the place of costly, specially designed equipment.
7. Chlorine costs are eliminated or lowered because aluminum sulfate does not require oxidation to make it free out.
8. Simple adjustment of only one feeding device requires a minimum of operator's time.
MAY BE DRY OR SOLUTION FED ••• CLEAN, DOES NOT STAIN ••• STORES INDEFINITELY! REDUCES CORROSION COSTS
Granulated aluminum sulfate may be dry fed from suitable machines, or it may be solution fed (the latter method offers no particular handicap since aluminum sulfate is readily soluble even in cold water). It stores indefinitely in a dry room, losing none of its effectiveness. It is a clean product that leaves no ugly stains on floors or equipment. It is the least corrosive of the coagulents now in use, thus reducing corrosion, and consequently, maintenance of equipment and piping.
Aluminum sulfate, used for years in water clarification is, through the application of the same principles, solving the problems of sewage clarification. Just as aluminum sulfate removes turbidity, organic and inorganic material and color from potable water, so will it float out suspended material and color in waste waters. With effective mixing and settling, the same "alum sparkle" will prevail in the crystal clear effluent of the sewage plant as in the water plant effluent.
Coagulation of sewage is influenced by such factors as pH, alkalinity, buffer salts, color, inorganic suspended matter and soluble and insoluble organic compounds. Domestic sewages have, on the average, a pH of 6.0 to 8.0 and sufficient alkalinity to complete the reaction with the coagulant. Buffer salts, color, turbidity and organic compounds are usually not present in amounts sufficient to interfere with the aluminum sulfate reaction. Plant experiences indicate effective treatment with aluminum sulfate over a wide range and constitutions of these factors.
HOW ALUMINUM SULFATE WORKS IN PRECIPITATION OF SEWAGE
Aluminum sulfate, when added to water or sewage, separates into innumerable charged particles called aluminum ions and sulfate ions. The positively charged aluminum ions are neutralized by negatively charged bicarbonate ions already present from the calcium bicarbonate in solution in sewage. Carbon dioxide gas is evolved from the reaction and aluminum hydroxide (alum floc) enmeshes the fine solids in suspension. The negative sulfate ions are neutralized by positive calcium ions to form calcium sulfate, which remains in solution.

• • • CONCERNING THE USE OF ALUMINUM SULFATE FOR WATER PURIFICATION AND SEWAGE TREATMENT • • •

LAST CALL!



There are only a few of these informative pamphlets still available for distribution . . . and any one who is concerned with this subject should read this pertinent discussion of water and sewage treatment.

The pamphlet is a clear and concise discourse on the properties of Aluminum Sulfate and its use. Such topics as removal of tastes and odors, how aluminum sulfate works in precipitation, methods of application, clarification of industrial wastes, advantages of sludge drying with aluminum sulfate and a number of other important phases of water and sewage treatment are fully discussed.

Particular care was taken in the preparation of this material to insure that the layman would find the pamphlet interesting and understandable . . . at the same time, however, all the material is of a nature that the technical man, in reading it, will find informatively worth while. Just fill out and send in the coupon—there is no obligation.

GENERAL CHEMICAL COMPANY • 40 Rector Street, New York, N. Y.

Gentlemen: Kindly send me your new pamphlet on the use of aluminum sulfate in water and sewage treatment.

Name.....

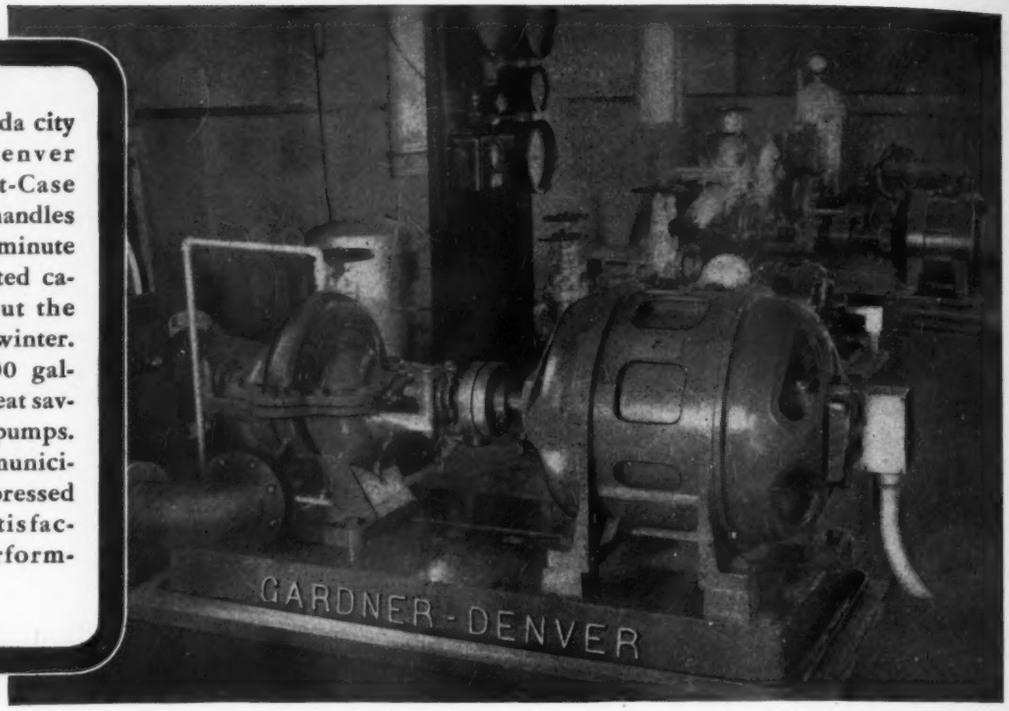
Affiliated with.....

Address.....

City.....*State*.....

WWS-840

IN a Florida city this Gardner-Denver Horizontally Split-Case Centrifugal Pump handles 125 gallons per minute MORE than its rated capacity—throughout the peak season of the winter. It pumps 1,650,000 gallons per day—at great saving over previous pumps. Executives of the municipal plant have expressed their complete satisfaction with the performance of this unit.

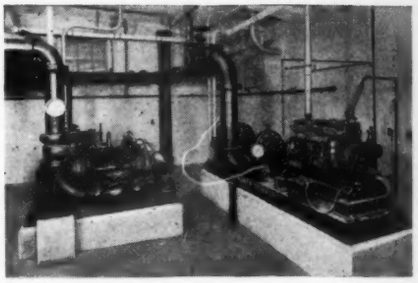


PUMPING DOLLARS BACK TO TAXPAYERS

THRIFTY cities all over the country are turning to Gardner-Denver Centrifugal Pumps. They have found that the cost per 1000 gallons pumped falls when a Gardner-Denver takes over.

Truly modern design, embodying important hydraulic and mechanical advantages, gives Gardner-Denver Centrifugals higher efficiency and lower power cost—adding up to savings that often pay for pump and motor in a year's time!

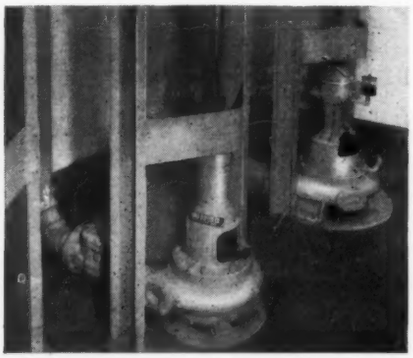
Taxpayers will appreciate the money you can save them by replacing your present pumps with Gardner-Denver Centrifugals. For complete information, write Gardner-Denver Company, Quincy, Illinois.



An Illinois city is saving taxes with these Gardner-Denver Centrifugal Pumps installed in their municipal plant.

A city in New York is getting high efficiency operation from this Gardner-Denver Sewage Centrifugal Pump in their municipal plant.

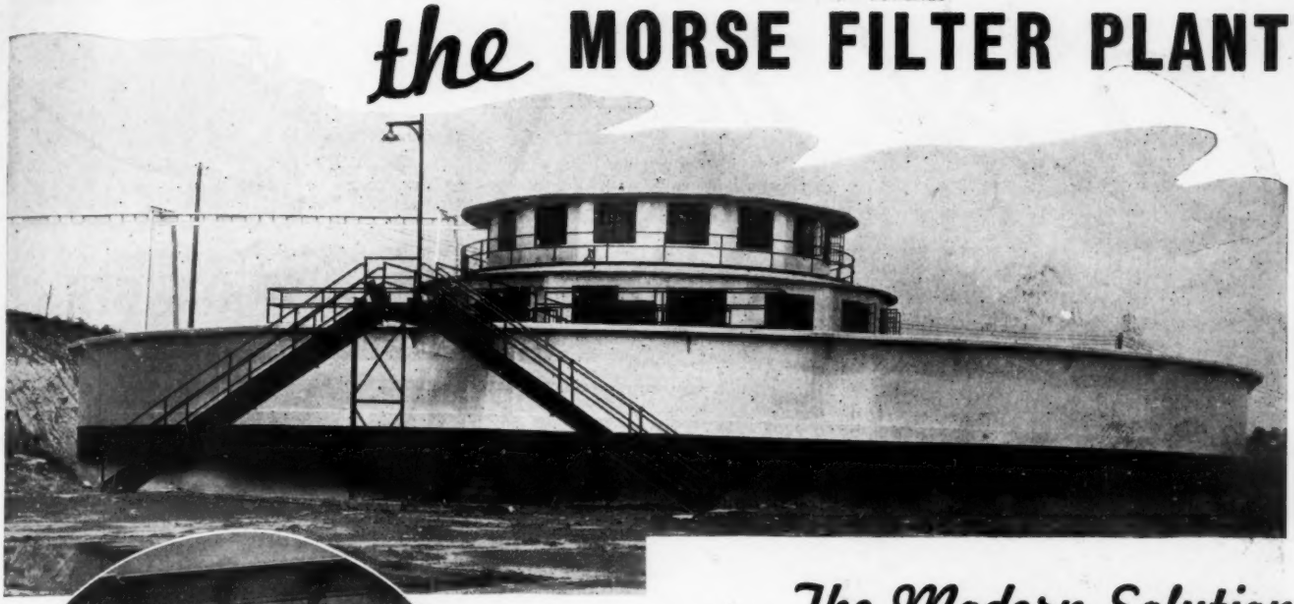
An Iowa city pays one cent for every 3000 gallons pumped by this Gardner-Denver Centrifugal Pump.

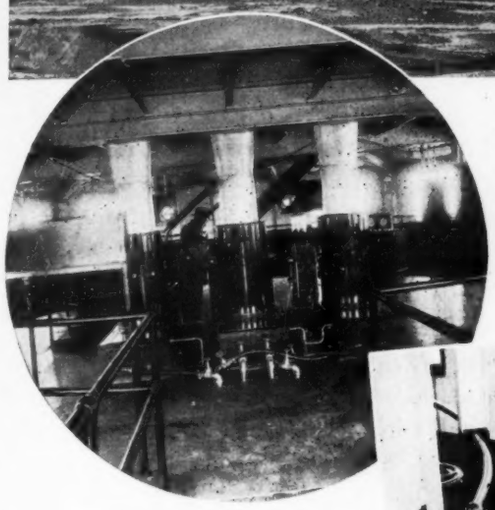


A suburb of New York has cut power costs with this Gardner-Denver Sewage Centrifugal—just one of four installed.

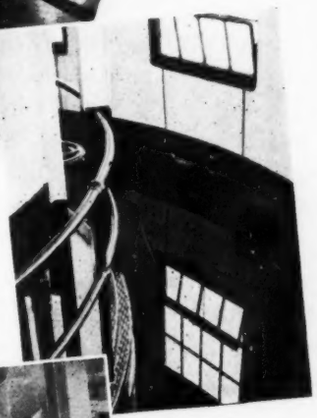
GARDNER-DENVER SINCE 1859

the MORSE FILTER PLANT

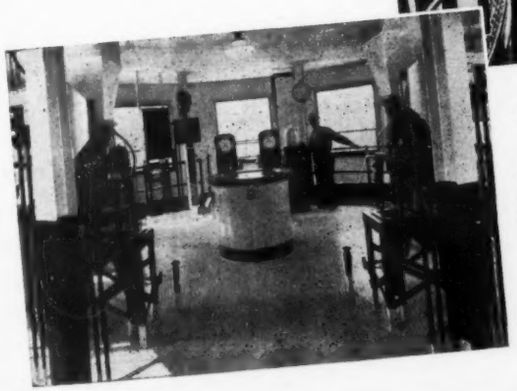




Above: Morse Filter Plant in service at Irvin, Pa. Left: View of the operating floor at the center of the filter unit.



Right: Interior view of 720,000 g.p.d. Morse unit at New Bethlehem, Pa., showing a filter bed during washing.



Left: Operating "circle" with sight well in the center of a typical Morse Plant installation.

... The Modern Solution to FILTRATION PROBLEMS

WHEN your city is confronted with the problem of modernizing—enlarging—or erecting new water filtration facilities, it will be to your advantage to investigate the possibilities offered by Morse Filter Plant units.

Steel construction offers the same advantages that are available in water storage tanks and reservoirs —no seepage, no cracking and less maintenance expense. The concentric design requires a minimum of space per m.g.d. of capacity. This is particularly advantageous where large level areas are not available and where land values are high.

The Morse Filter Plant also offers definite advantages in operating efficiency. The small loss in head through the plant results in lower pumping costs. Variations in operating rates are easily accommodated. Control is centralized to make supervision simple and easy. Cleaning and maintenance is easier, quicker.

Let us show you what these advantages can mean in dollars and cents to your water department. There is no obligation on your part. Please address our nearest office.

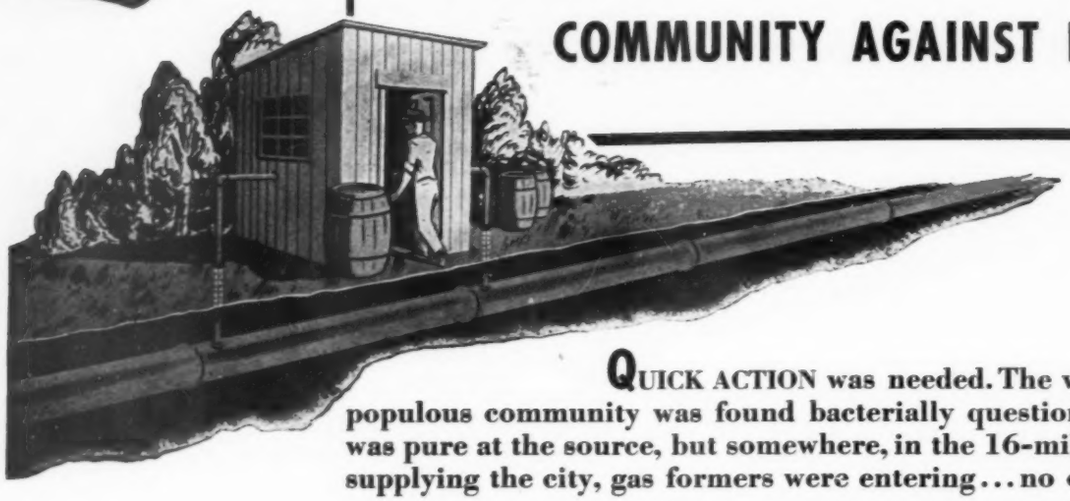
CHICAGO BRIDGE & IRON COMPANY

Chicago	2198 McCormick Bldg.	Birmingham	1586 North 50th Street	Philadelphia	1644-1700 Walnut St.
New York	3390-165 Broadway Bldg.	Tulsa	1646 Hunt Bldg.	Boston	1548 Consolidated Gas Bldg.
Cleveland	2262 Rockefeller Bldg.	Houston	918 Richmond Avenue	San Francisco	1083 Rialto Bldg.
Dallas	1679 Praetorian Bldg.	Detroit	1551 Lafayette Bldg.	Los Angeles	1455 Wm. Fox Bldg.

Plants at BIRMINGHAM, CHICAGO, and GREENVILLE, PA. *In Canada:* HORTON STEEL WORKS, LIMITED, FORT ERIE, ONT.

Quick Treatment

WITH PERCHLORON PROTECTED THIS COMMUNITY AGAINST DANGER



QUICK ACTION was needed. The water supply of a populous community was found bacterially questionable. The water was pure at the source, but somewhere, in the 16-mile pressure main supplying the city, gas formers were entering... no one knew where.

The time required for a systematic search would leave the community unprotected too long. The supply had to be sanitized immediately without waiting for special chlorinating equipment.

Perchloron made quick, effective action possible with the greatest ease. Two taps in the pressure main near the water source were connected by means of piping and a small electric pump, and Perchloron solution was fed steadily into the suction of the pump. The quantity added was sufficient to attain a residual of 0.3 p. p. m. chlorine after 20 minutes' contact. The long length of the main provided the desired contact.

By this means the gas formers were eliminated. The community was assured of a safe water supply until the source of the pollution could be discovered and the trouble corrected.

This is but one example of the way in which Perchloron fits in. It is used for sanitizing new mains, for clear wells and filters, and for swimming pool sanitation. It is your easily adaptable emergency supply of chlorine. It is a dry, free-flowing granular material containing more than 70% available chlorine. Ready-to-use solutions are quickly prepared by dissolving Perchloron in tap water.

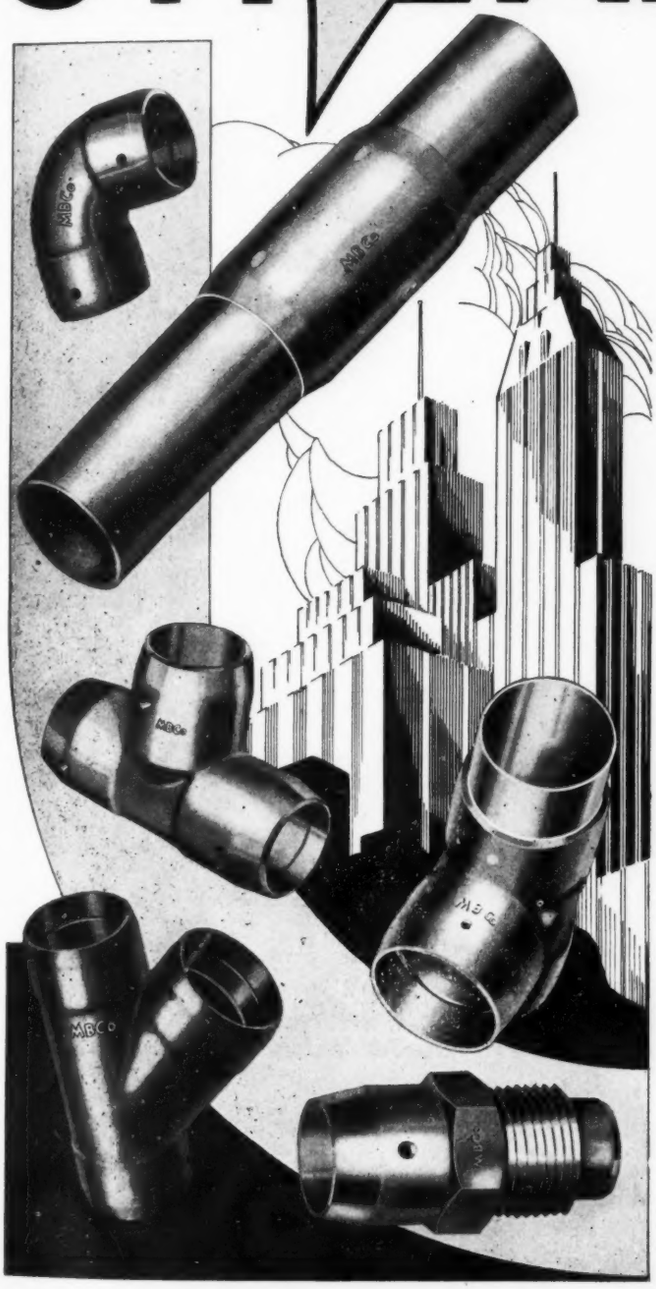
Perchloron is stable, concentrated, uniform. Packed 9 handy-sized cans to the case, each can with Kork-N-Seal cover. Also in 75-lb. drums. Write for free, illustrated booklet. Pennsylvania Salt Mfg. Co., Widener Bldg., Phila., Pa.—New York • Chicago • St. Louis • Pittsburgh • Tacoma • Wyandotte.

Perchloron

PENNSYLVANIA SALT MANUFACTURING COMPANY

Chemicals

WHEN YOUR CITY PLANS CALL FOR PIPE AND FITTINGS Check STREAMLINE



A STREAMLINE copper piping installation, whether it be for plumbing, heating, industrial or water works use is the most modern and efficient system on the market today.

STREAMLINE fittings are not connected by threading or flaring the pipe but by an entirely new and revolutionary method that utilizes nature's law, capillary attraction, to form one of the tightest and strongest joints known to the trade.

STREAMLINE copper pipe cannot rust and since it is not connected by threading, the wall need not be so heavy. Pipe which is threaded to connect must have a much heavier wall because the thread diminishes its thickness and the strength of the pipe is therefore limited to this diminished wall thickness while on the balance of the pipe expensive surplus material remains but gives no service for its additional weight and consequent cost.

STREAMLINE copper pipe utilizes only that wall thickness required for actual service and the fitting actually reinforces the connection, making it the strongest point, while with threaded pipe it is the weakest.

A STREAMLINE service line is vibration proof. The effect of vibration is harmlessly dissipated over the entire installation and not localized at the joint. Settlement of filled earth or water mains, etc. does not affect it. STREAMLINE fittings and copper pipe are the ideal materials for water works use; for many applications in filtration plants; in aeration lines and in heating coils using the sludge digestion system in sewage disposal plants—and for all general plumbing and heating purposes.

When your city plans call for pipe and fittings for any purpose, consider STREAMLINE materials carefully before you buy.

Send for STREAMLINE Catalog W-3.

STREAMLINE
PIPE AND FITTINGS DIVISION
MUELLER BRASS CO.
PORT HURON, MICHIGAN

FATHER AND SON

—the Symons . . . two generations of

SANITARY ENGINEERS

Says George E. Symons of his father,

"To condense into one page the professional life of a man like Martin, as all his men call him, is unfair. . A period of service like his deserves a volume. . He takes his job seriously, believes firmly in the credo of the public utilities servant, 'It's got to go' . . Packing men ask his advice, pump men seek his counsel on valves, professors have brought classes to see how he wets coal to make it burn better. He can still look at an alum floc and tell how well the water will filter. He likes to tell the story of how No. 1 High Service Pump was started the day I was born, and how the filter plant began operations when I was forty days old . . (His) plant is the most economical in the State . . 'Martin' is the dean of operators in Illinois, with service since 1895."

(upper)
Martin M. Symons, Chief Engineer, Interstate Water Co., Danville, Ill.

(lower)
George E. Symons, M.S., Ph.D., Chairman, Committee on Sewage Research, New York State Sewage Works Association.

● The Symons first became acquainted with the virtues of Mathieson Chlorine in 1916 when it was introduced in the Danville plant, of which Martin M. Symons has been Chief Engineer since 1909. Since that time, both father and son have used Mathieson Chlorine throughout their long careers in sanitary work.

The popularity of Mathieson Chlorine with sanitary engineers all over the country is due to its purity and dependability, and the excellent service record of Mathieson's trouble-free cylinders and valves.

Popular, too, is Mathieson HTH, a dry, free-flowing chlorine carrier containing more than 70% available chlorine. Many sanitary engineers keep it on hand at all times for sterilizing new or recently repaired mains and for emergencies requiring a mobile, high test chlorine carrier.

THE Mathieson Alkali Works (INC)

60 EAST 42ND STREET, NEW YORK, N. Y.

LIQUID CHLORINE . . . HTH . . . SODA ASH . . . CAUSTIC SODA . . . BLEACHING POWDER . . . BICARBONATE OF SODA . . . AMMONIA, ANHYDROUS and AQUA . . . PH-PLUS (FUSED ALKALI) . . . DRY ICE . . . CARBONIC GAS

LABORATORY CORROSION TEST proving how small amounts of Calgon reduce corrosion of iron or steel. The steel wool exposed to plain tap water corrodes rapidly and the effluent discolors the glass beads through precipitation of dissolved iron. With the Calgon-treated water, rusting of the steel wool is prevented or greatly reduced and the glass beads remain free from red stains of iron oxide.

MICRO-CALGONIZE YOUR WATER NOW.

YOU CAN CONTROL CORROSION

Prove it yourself with CALGON

BY adopting treatment with Calgon at rates varying from 0.5 to 2 parts per million, more than 50 cities have already removed corrosion and resultant "red water" from their list of problems.

While this *sounds* convincing, it pays to be a skeptic, so to you we say "Prove it Yourself!" Prove it with your *own* water to your *own* satisfaction. Subject Calgon to the toughest test ever made on any corrosion-control treatment.

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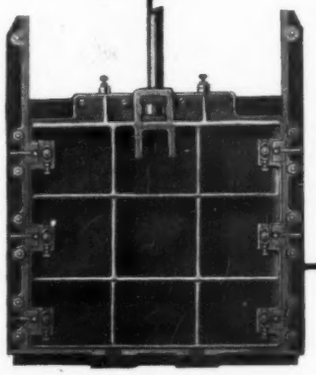

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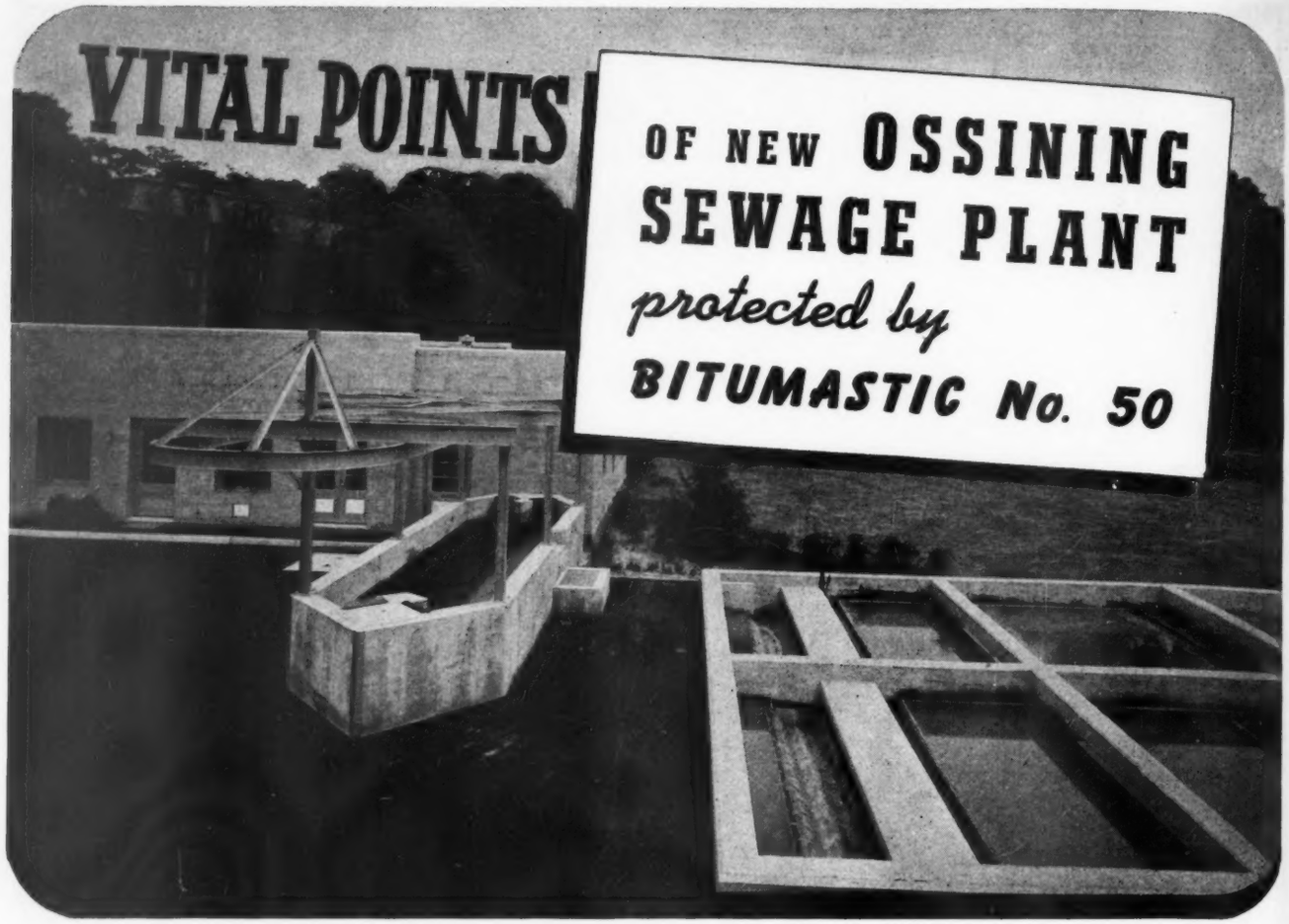

Interior walls of grit chamber (left center) of Ossining Sewage Treatment plant—protected by Bitumastic No. 50. James C. Harding, Consulting Engineer, New York City. Contractor: Robert Young Construction Company, Hartsdale, N. Y.

At Ossining, New York, a new sewage treatment plant, using sedimentation, separate sludge digestion, and having a capacity of 2 m.g.d., has just been put into operation.

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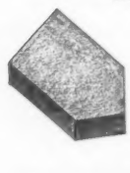

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COMING!

"The New Softening Plant of Ann Arbor, Mich."

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H. H. CASWELL, Manager
H. T. McENTEE, Sup't. of Purification
L. E. AYRES, Designing Engineer

"The Biofiltration System in Sewage Treatment"

Is a review of performance records of high rate (high capacity) trickling filters in service, and a discussion of applications of this newer method of purification for a great variety of duties. Especial attention is given the ability of this method to take shock loads seasonally and its worthiness in industrial waste treatment. The author—

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The Dorr Company, New York, N. Y.

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Is the invention of a water works superintendent and manager which will interest operators because of its simplicity, positive tightness, flexibility, and the elimination of all bacteria harboring joint packing materials. The author (and inventor) is—

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"The New Filtration Plant of Raleigh"

Will be described in a featured article which will emphasize novel elements in the design and equippage of the recently completed filter plant of Raleigh, North Carolina. This plant is reputed as being the finest in the South and complete to a detail. The author, and designer—

WM. C. OLSEN, Consulting Engineer
Raleigh, North Carolina

"Air Blowers in Activated Sludge Plants"

Is a paper which constitutes a treatise on rotary-type air blowers, discusses the principles of design, duty, and operating performance characteristic of such blowers. It also takes up recent developments and improvements made in rotary type blowers and describes and pictures a number of modern installations in representative activated sludge plants. The author is—

D. L. DOWLING
Roots Connersville Blower Corp.

(An article on centrifugal type blowers will also appear in the September issue if ready in time. If not, then in a following issue.—Ed.)

"Some Fallacies in Respect to Lawn Sprinkling Practices"

Will interest many a water operator who may find this authoritative statement of value in encouraging consumers to do lawn sprinkling during mid-day and thus distribute the daily sprinkling load more equally.

"Field Cost Keeping"

Is filled with helpful suggestions to simplify this subject that appears to needlessly frighten the average water works or sewerage operator. The author, who has been "keeping track" of costs on construction jobs for a number of years, speaks in a readily understandable language to help others to see that while "Cost Keeping" sounds formidable enough, it is not any more difficult than "keeping track". He is—

WALDO M. PORR
Asplund Construction Co. of Enid, Okla.

"Experiences With Publicity Methods"

Constitutes a story of how the successful program of "selling" the Portland Water District supply and services to the public was accomplished, at reasonable and justified expense. The article comes from—

FRED. J. RENY, General Manager
Portland Water District, Portland, Me.

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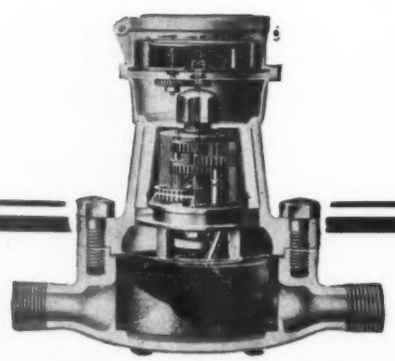

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WATER WORKS & SEWERAGE

VOL. 87, NO. 8 *A Gillette Publication* AUGUST, 1940

OIL FIELD WASTE WATER DISPOSAL

As Practiced in Three Plants Serving Southern California Fields

By WALTER HUMPHREYS[1]
SANTA FE SPRINGS,
CALIFORNIA

and

A. M. RAWN[2]
LOS ANGELES
CALIFORNIA

Authors
Humphreys and Rawn

The editors of WATER WORKS AND SEWERAGE *have planned a continuing series of articles on this topic of growing importance—Treatment and Disposal of Industrial Wastes.*

In our March issue, Dr. F. W. Mohlman's superb review of "Progress in Industrial Waste Treatment" was the introductory and inspiring contribution. Then in May followed the article of Louis R. Howson, relating the effective use of high rate—high capacity bio-filters in the "Treatment of Packinghouse Wastes."

The present article by Walter Humphreys and A. M. Rawn, Western Associate Editor, relates practices and accomplishments to date in treating the difficult and voluminous wastes from oil fields. Their second article will reveal what has been learned through continuing studies and large scale experimental plant operation, undertaken to improve the treatment and disposal of such wastes. If anywhere else this acute problem has been given more thought and scientific study we do not know of such. Their second article will contain hitherto unavailable information, which those concerned with disposal of such wastes can put to valuable use.

We feel particularly fortunate in being in the position of publishing findings of the investigations which have been made at a high cost to Southern California's oil companies, in a pooled effort to more effectively solve problems which came with the discovery of "liquid gold".

DURING the early development of the oil industry in California and elsewhere, it was felt that waste water from oil wells, dehydrators, absorption tanks, boilers and refineries within the fields, could be satisfactorily disposed of by simply removing that portion of the mixed oil content which would separate by simple flotation, and running the water taken from the separating tanks or ponds through natural drainage courses to whatever place or point of disposal was nearest at hand. In the coastal fields of Southern California such disposal was down the courses of dry-washes to tidewater.

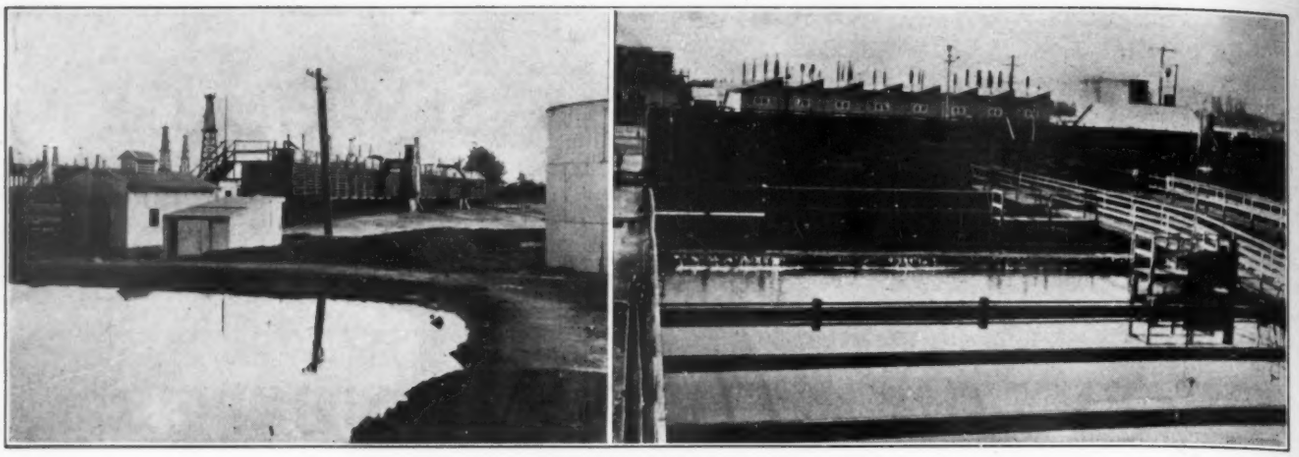
In time, as conditions developed in the expanding oil industry, larger quantities of wastes were generated. It became apparent that important and far-reaching effects were accruing as a result of the indiscriminate and thoughtless methods of disposal, and that prompt remedial measures were in order.

An understanding of what is contained in oil field waste waters is helpful to a realization of what pernicious after effects may result from surface disposal schemes. Such a conception will assist one to appreciate why the oil companies spend more than $4,000,000 annually in California for the treatment and disposal of this industrial flow.

Character of Waste Waters

To begin with, the water is highly saline. In general it will contain about one-fifth as much salt as sea water. This quite obviously renders it unfit for use in irrigation, or domestic or industrial uses. In addition, this salty water is extremely dangerous as a source of contamination of underground water strata; and, where potable

[1] Manager, Santa Fe Springs Waste Water Disposal Company.
[2] Ass't Chief Engineer, Sanitation Districts of Los Angeles County, and Associate Editor, WATER WORKS AND SEWERAGE.



The Santa Fe Springs Plant

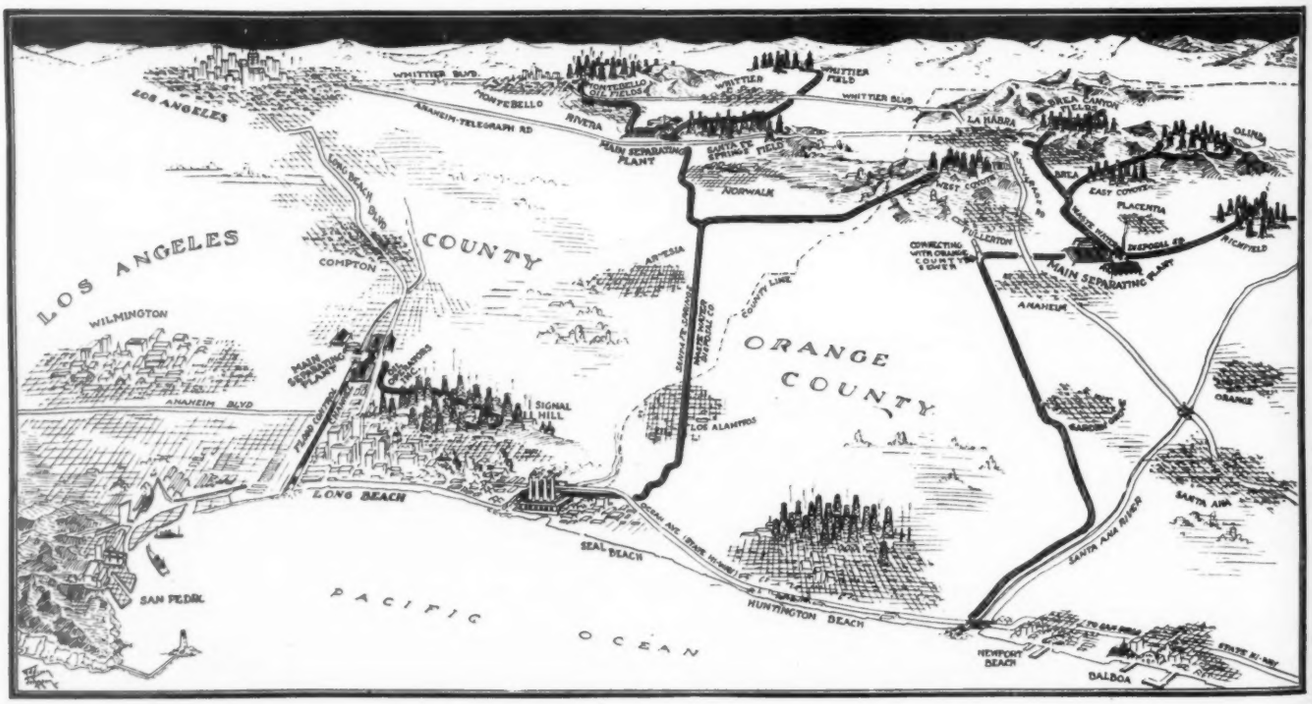
(Left) A View of the Aerator Tower From the Rear; at Center the Inlet Riser Discharging to Distribution Flume Seen in Another Picture. (Right) Looking Across the Secondary and Primary Settling Units From the Excelsior Effluent Filters Toward the Aerator Tower in Rear. (The saw-tooth roofed building beyond is a compressor house and has no connection with the plant. For a clearer understanding of plant pictures refer to sectional drawing)

water is as valuable as in Southern California, salt water pollution of the strata from which water supplies are being drawn amounts substantially to economic suicide. From this standpoint alone it is essential that these waste waters be conveyed through water-tight channels or conduits to final disposal.

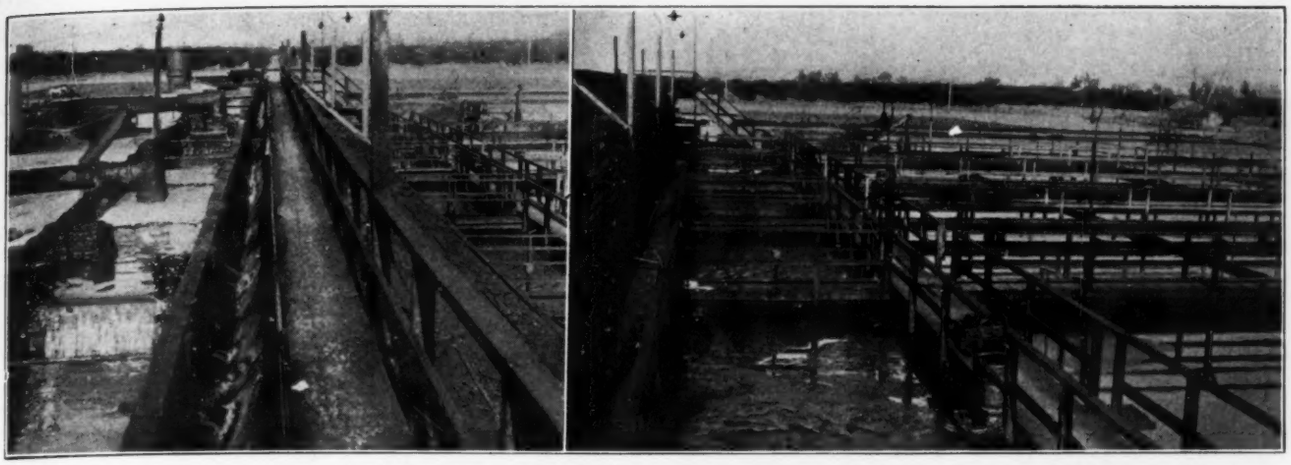
In addition to the salt content, the waters are quite heavily impregnated with oil, contain a large amount of mud employed in rotary drilling, and considerable organic material. It may surprise many to learn that they usually have a high bacterial count and are comparatively warm, ranging upwords from 80° F. The oil content also complicates the situation so far as irrigation and other surface use is concerned. Although it is not likely that the oily components would penetrate very deeply into the soil and thus pollute the underground water strata, it gives the water sufficient odor and taste to greatly magnify the obnoxious characteristics which would result from salt water pollution.

Holding such a waste in lagoons and estuaries, if it contains a measurable quantity of oil, results in a sealing film on the water surface which effectively prevents oxygen absorption into the water, and marine life is thereby suffocated. This is particularly true of shell fish, and whosoever disposes of oil impregnated wastes in such places will immediately have to answer to the Fish and Game Commission.

Rules and regulations which have been built up to regulate this type of disposal, state in brief that it is against the law to discharge any wastes which will pollute or contaminate the underground fresh water strata. Further amplified, they state that it is against the law to force salt water wastes back into the ground through abandoned wells in California. This leaves the operators with the alternative of evaporating the water or disposing of the properly treated waste at tidewater or in other salt water bodies. The Fish and Game Commission, supported by the U. S. Coast Guard and the Army Engi-



Three Waste Disposal Systems of Southern California Collect and Treat the Waste Waters of Nine Oil Fields



(Left) Atop the Aerator Tower, Looking Down the Distribution Channel on Left. And a Step to the Right a View Along the Face of the Aerator and Across the First Oil Collecting Chamber. To the Right Further are the Deep Primary Settlers With Baffled Oil Pockets

neers, state that it is against the rules to dispose of waste in such a manner as to shoal navigable waters or have a harmful effect upon marine life.

Thus there can be no side-stepping of proper collection, adequate treatment and correct disposal of oil fields wastes in the tidewater lands of Southern California; and, from past observations and experiences have grown the oil field waste water disposal plants and companies in the area.

In 1921 Signal Hill Yields "Liquid Gold"— In 1927 the First Attempts at Waste Disposal

Oil was discovered at Signal Hill in 1921. In the rush to sink wells to the producing zones, drillers concentrated on making as much hole per day as possible, many times overlooking the importance of adequate disposal of rotary mud—which disposal now costs from $800 to $1,000 per well drilled. In 1927, following serious collisions with the law, at a conference of representatives of the major companies a corporation known as Oil Operators, Inc., was organized for the purpose of collecting, treating and disposing of waste waters from the Signal Hill oil field.

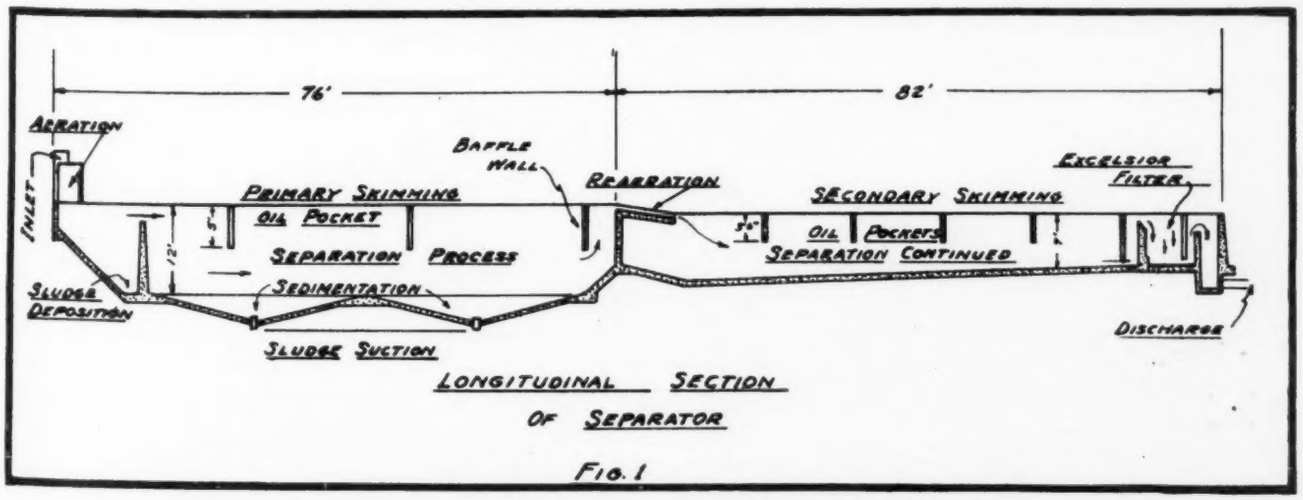
With a capital of $60,000, this non-profit corporation purchased 38 acres near Long Beach, California, adjacent to the Los Angeles River flood control channel, and built sumps of sufficient capacity to hold a million cubic yards of waste rotary mud from drilling operations. Waste water, containing the mud slurry, flows through the sumps at low velocity. Entrained oil rises to the surface and is removed by skimming, while the suspended mud and other materials settle to the sump bottoms.

The Signal Hill waste disposal plant was placed in operation in the spring of 1927. In the fall of 1928 a similar plant was constructed south of the city of Fullerton (Orange County) to treat oil field wastes from a number of fields developing in that area. The Fullerton plant is no different from that at Long Beach. It consists in the main of subsidence and flotation basins, with the clarified water running thence through a pipe line to the Orange County outfall sewer and to disposal with other Orange County (settled) sewage 3,000 feet seaward from the ocean shore at the mouth of the Santa Ana River.

The Santa Fe Springs Plant

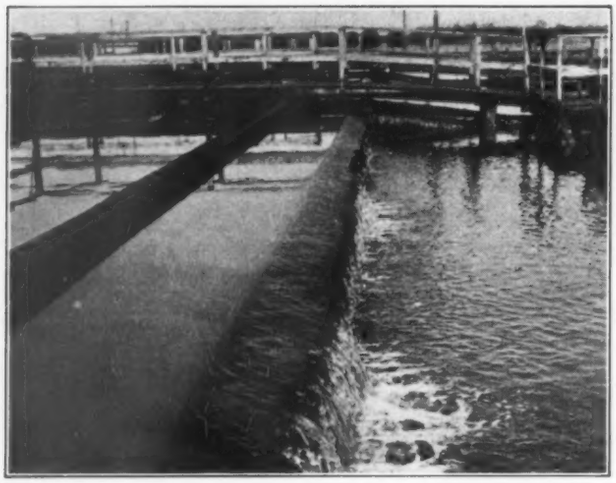
(Pictured on the Front Cover)

Most interesting of the three plants constructed in the area is that at Santa Fe Springs. Placed in operation in the spring of 1929, it treats salt water and other oil field wastes from the Santa Fe Springs, Whittier, and



A Section Through the Plant Which Treats 4 M.G.D. of Oil Field Wastes

(From these wastes are reclaimed 4,000 gallons of oil as the average daily yield to return $20 of the $25 per m.g. maintenance and operating cost. Fixed costs, however, add another $50 to the per mg. cost of treatment)



Between First and Second Stages of Clarification a Second Aeration Occurs

(Note the heavy oil blanket to the left of the hanging baffle in the first stage clarifier. More oil separates following the second aeration.)

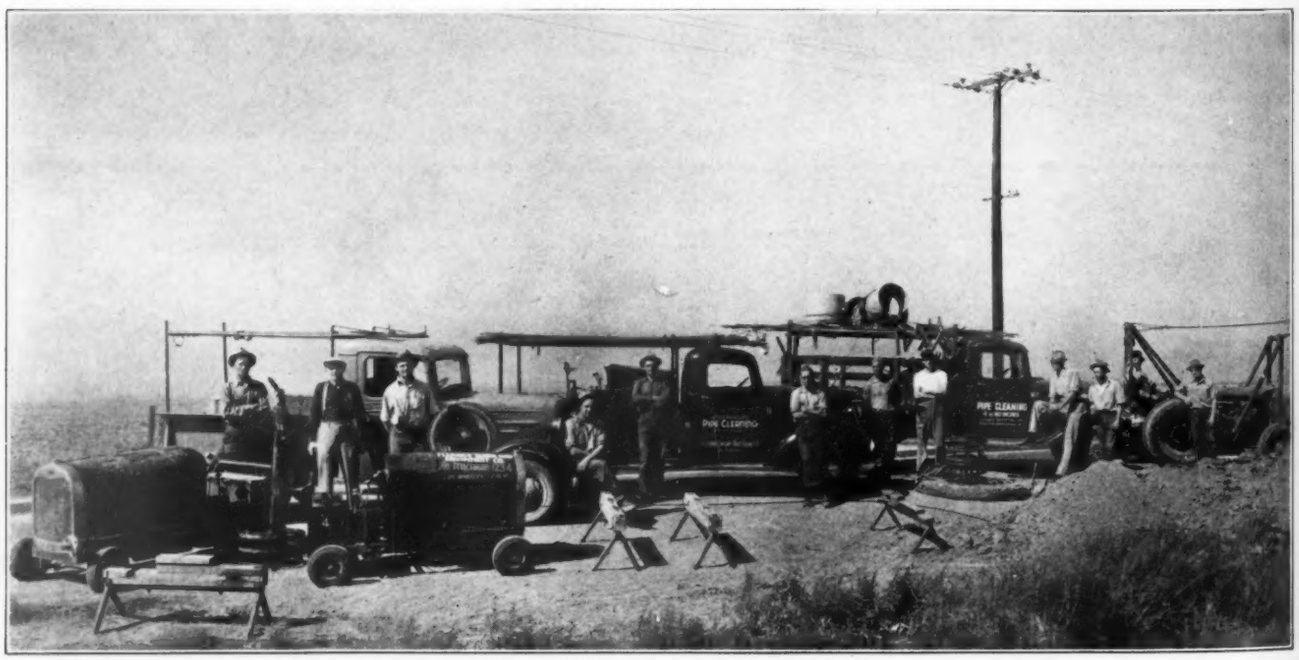
Montebello fields; while its outfall serves, in addition, the West Coyote field. It differs from the other two plants in that in its design are incorporated features resulting from a thorough study of the effects of velocity, depth, baffling, and temperature, upon subsidence and flotation. And in addition the important study of the effects from pre-aeration of the warm waste waters. It is one of the most highly developed and technically correct of any of the plants treating oil field wastes in California.

The plant at Santa Fe is situated upon a seven-acre tract about two miles south of the city of Whittier. Wastes from three nearby fields flow by gravity or are pumped through the waste companies' collecting trunks to the plant site. Flows from each participating company's development are measured with V-notched weirs and recorded by the disposal company's officers for use in allocating costs for operation of the system and treatment plant.

The collection system presents a serious problem in maintenance, owing to the high mineral content of the waste water and its tendency to form a hard and resistant scale in the collecting lines. At times not more than four to six months is sufficient to completely stop up a collecting line, and an extensive maintenance crew is almost continuously on the job keeping the lines open. For removing the scale no method short of that in which a hard (abrasive type) of cutting screw (called a "go-devil") is forced through the line seems to do a satisfactory job of removing the dense precipitated material. Although the cause of this difficult scale formation is not fully understood, it is generally believed that wastes from different wells combine to produce the precipitate of calcium carbonate and organic binders. In the Signal Hill field, costly trouble in the collecting system is likewise experienced but is of a different nature. There the waste water contains a large amount of sharp sand in suspension, and it cuts through cast-iron pipes in four or five years. The remedy for this is to remove the pipe, repair the worn through side by welding, and relay the pipe in position to expose a new-wearing invert. In practice a length of pipe can be rotated through 90 degree angles at each relay, thus prolonging its life about four-fold.

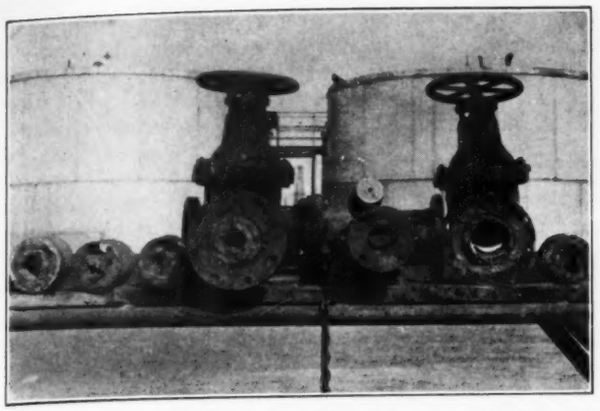
Treats 4 M.G.D. of Waste

At the Santa Fe plant an average of four million gallons per day of waste is treated. The plant was built only after operation of a large-scale experimental model. In these studies careful adjustments were made to observe effects of baffle heights, velocities of flow, periods of aeration, as well as adjustment of temperature and the use of filters composed of packing excelsior. The result was the construction of three units, each 50x150 feet in plan, and each comprising two basins in series; the primary being 12 feet in depth, and the secondary about 8 feet. Through a clay riser pipe the wastes enter a flume atop the aerator tower and flow along the long axis of the tower, while spilling from this flume over the



Busy Outfits are the Pipe Cleaning Crews on the Waste Disposal Systems

(The reason appears in pictures following. What appears to be toy autos are the little machines that twist the Flexible Rod to the head of which is attached the cutting tool)



A Few Reasons Why the Cleaning Crews are Kept Busy
Some typical closures of pipes and valves by hard to cut formations of calcite scale and cementitous organic binder.

aerating louvres. The aerated liquid drops into the combination subsidence and flotation chamber, where much of the mud drops out and the more easily separated oil floats. Hanging baffles confine the oil blanket to the chamber, and the under-flow of partially clarified liquor enters the deep primary (first stage) subsidence and skimming chamber, where floating oil is stopped behind successive baffles as it travels across the chamber. The separated oil is taken from the water surface by flowing it into funnel-like scuppers set near the baffles. The oil-water mixture passes to a concentration chamber for final separation.

Settled material is pumped from the hoppers in the bottom of the primary tank. At the effluent end of the primary tank the clarified liquid receives additional aeration as it spills into the shallower secondary tank where a second stage of flotation and subsidence is provided. The effluent leaving the secondary tank flows downward through a compartment filled with excelsior.

Removals and Difficulties of Attainments

Up to this point the process is successful in removing about 95% of the 1,000 parts per million of contained oil and virtually all settleable solids which consist of the waste mud, algae, etc. From the excelsior filter the waste flows into an asphaltum-lined basin (about four acres in extent) for final subsidence, skimming and cooling. The effluent from this final basin passes through a metering box to an outfall leading to tidewater in Alamitos Bay.

A number of factors contrive to render treatment of the oil field wastes quite difficult. The water is of high specific gravity, suspended particles are oil-coated and rotary muds are clays. All three conditions are subsidence retarding in their effects. Relatively high temperatures of the liquid makes for difficulties in oil separation, while bacterial activity is so great that long periods of retention in tanks and basins result in excessive production of the products of biological degradation; notably, hydrogen sulphide. Despite these difficulties, wastes leave the plant with an average of less than 20 parts per million of oil, fairly well cooled, and although darkened by iron sulphide, are reasonably free from suspended matter.

From the treatment plant to tidewater is fifteen miles. In 1929, when the plant was constructed, the company built a vitrified clay outfall to the ocean. The pipe line ranged from 14 to 24 inches internal diameter and joints were constructed of asphaltum. The warm septic wastes were responsible for the loss of resiliency of the asphaltum in the joints and much of it leeched out. That which remained was so softened as to permit the pipe to settle and leak badly when running at full capacity. To remedy the situation and provide additional capacity, the Company paralleled the old line in 1936 with another of 16-in. to 36-in. diameter, built of vitrified clay and joined with an acid-resistant material known as "Penchlor" Cement.* To date this jointing compound has proved satisfactory, and both lines are now in constant use.

Main Cleaning

When clean, the two outfalls have a combined capacity of 6.5 m.g.d. When the combined capacity drops to 4.2 m.g.d. it is time to begin cleaning operations. It is customary to clean each line every two years, alternating so as to provide one clean line each year. Many tons of the hard, resistant carbonate incrustations are removed annually. Protection of this line and its manholes from the destructive action of oxidized sulphide gas has been a problem. At present the many manholes are being reconstructed of vitrified clay brick with acid resistant mortar joints, and protected cast-iron manhole covers. Wherever necessary, the original line has been rebuilt to render it serviceable, and with completion of the present manhole repairs, all interior surfaces of the pipe and manholes will present an acid-resistant surface to the waste and its gases.

A Continuing Search for Improved Methods

Despite the overall efficiency of the present Santa Fe works, the Company has been constantly on the alert during the period of plant operation since 1929, for more successful means of oil and mud separation. The Santa Fe Springs Waste Disposal Co. has for the last three years continuously maintained an experimental works at the plant site, employing research workers to investigate divers methods of waste treatment. It is believed that existing information is such that, when incorporated

* A product of the Pennsylvania Salt Mfg. Co., which has been described in the new products section of an earlier issue of this magazine.—Ed.

A Close-Up of Scale Deposit and the Type of Cutting Tool Employed

in the plant design, such will permit the removal of essentially all of the remaining 20 parts per million of entrained or emulsified oil and most, if not all, of the suspended material. Discussion of these developments, and findings from other experiments conducted at the site, will be contained in an article to follow.

Costs

The Santa Fe Springs Works, including collection lines, plant and outfall, represents an investment of nearly $750,000. Operation and maintenance costs approximate $25 per million gallons, and interest and sinking fund requirements add $50 to make the overall cost approximate $75 per million. However, of this, some $20 per million gallons is returned to the owners in the value of crude oil recovered. At the Santa Fe plant this reached the tidy figure of 4,000 gallons per day.

In passing, it is worth noting that the three Southern California plants have recovered from oil field wastes nearly 2,000,000 barrels (not gallons) of oil and have treated in excess of 21 billion gallons of waste water. The oil recovered contains little or no gasoline, and is consequently disposed of almost entirely as road and fuel oil.

By contrast with the financial structure at the Long Beach works, that of the Santa Fe Springs Waste Water Disposal Co. is as follows:

The method of assessing the oil operators for their respective share of the cost of construction, maintenance, and operation of the system is interesting and unusual. Each operator is assessed in proportion to his use of the system. To define such use and provide a method of equitably transposing it into dollars and cents value, in service rendered, required much attention. "Use" could not be based upon an operator's acreage or number of wells thereon served by the system. Such is the case because circumstances may be such as to require one operator to develop all of his property or operate all of his wells, while another's may be dormant or idle.

The solution was found in the requirement that each user of the system pays that portion of the construction cost that the amount of water discharged and length of pipe line used by him, bares to the total amount of water discharged into the total length of the entire system. The initial payment is based upon the estimated use of each operator; one-fifth of the initial payment is adjusted annually for five years, based upon the actual use by the operator during the preceding year. Annual maintenance and operation costs are based upon the *actual* recorded use of the system during the preceding year. Each operator joining the Company is a member and contributes to the investment fund in proportion to his advance estimate of use.

Each of the three plants is operated by its own Company, all of which are non-profit organizations. While the value of recovered oil is a substantial amount, it is plainly evident that the $20 value (average) from each million gallons treated lacks $5.00 in returning the bare expenses of maintenance and operation. The net cost is therefore approximately $55 per million treated in the Santa Fe Springs plant, which treats on the average 4 M.G.D. The Long Beach Co. has been particularly fortunate, in that oil was discovered on its 38 acres of plant site and it has, in addition, located thereon the largest iodine extraction plant in the United States which, whether it operates or not, returns to the operating company a tidy sum monthly.

It is difficult to estimate how much these oil field waste water disposal plants have been worth to Southern California, or for that matter, to the oil companies. They have most certainly yielded big dividends to the owners and to the public, in damage suits and fines averted, in good will fostered and in valuable natural resources preserved. The destruction which would have followed indiscriminate waste disposal in the highly developed coastal plains of Los Angeles and Orange Counties would have run into millions of dollars except for the cooperative and constructive policy pursued by the responsible oil companies in adequately disposing of their wastes.

The second article in this series will relate progress made in continuing studies and practical scale demonstrations, looking to further improvements in treating these oil field wastes technically and economically.

Col. E. D. Rich Retires

John M. Hepler Becomes His Successor

Colonel E. D. Rich, Director of the Bureau of Engineering of the Michigan State Department of Health, has recently resigned this position, stepping aside to let a younger man take up where he leaves off after 27 years of fruitful service to the department, and a notable leadership in improving sanitation and public health in Michigan.

As a tribute to Colonel Rich, the following is the concluding paragraph from a splendid and deserved resolution passed by the Michigan Sewage Works Association, to cite the achievements of and regard for an admired character:

BE IT HEREBY RESOLVED, that we extend our sincere gratitude, our deep appreciation and our profound respect to Col. Edward D. Rich, a loyal public servant. We pridefully proclaim our profound affection and great admiration for Col. Rich, a gentleman of dignity and sterling character and inimitable personal attributes. To such a man, then, we pay homage and tribute and wish for this great and true friend the fullest measure of good health and happiness.

Copies of this resolution were sent to Michigan's Commissioner of Health and the Governor of the State.

To the position vacated by Col. Rich has been appointed John M. Hepler, who has long been connected with the Department and for several years Principal Assistant Engineer.

A. H. Fletcher Appointed to Hopkins Staff

Dr. Abel Wolman, Professor of Sanitary Engineering at Johns Hopkins University has just announced the appointment of Alfred H. Fletcher, former Sanitary Engineer of the Department of Health, Memphis, Tenn., as Associate in Sanitary Engineering.

Mr. Fletcher received a B.S. degree in Sanitary Engineering from Mass. Inst. of Technology in 1921, and a M.S. degree from Harvard University in 1932. In Health Department work he has seen service with the U.S. Public Health Service, the New Hampshire State Dept. of Health, and the Louisiana State Dept. of Health. For the past 11 years he has been Sanitary Engineer and Director of the Bureau of Sanitation in the Memphis Dept. of Health.

Mr. Fletcher will serve on the staff of Doctor Wolman.

SOFTENING PLANT OF THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

III.—Lime Reclamation—Its Place in the Economy of Softening and Alleviation of the Sludge Disposal Problem

By CHARLES P. HOOVER,* J. M. MONTGOMERY,* W. W. AULTMAN†
(Third of a Three Article Series‡)

WITH an ever increasing number of water softening plants being built in the United States, the disposal of the sludge produced during the softening process is assuming greater importance as a problem requiring a satisfactory solution. Although a number of plants are located adjacent to sizeable waterways into which the sludge has been discharged, the low stream flows of recent drouths, stricter stream pollution regulations, and increased plant output, renders it imperative in many cases to seek some more satisfactory solution of the problem.

It is usually the rule, that where water softening is most needed the streams are most deficient in flow. In some parts of the middle west and in most parts of the far west the problem is most critical. In the far west only a very few streams of sufficient size exist into which the sludge may be dumped. This is the situation which The Metropolitan Water District of Southern California faces in starting to operate plants to soften Colorado River water.

A Case of Wasteful Wasting

This problem is not one of sludge disposal alone but also one which involves the throwing away of vast quantities of potential raw material which contains the very same material from which is produced the necessary lime for the softening process. In other words the sludge produced when water is softened by the lime, lime-soda ash, or lime-zeolite method of treatment is composed principally of calcium carbonate. This same chemical compound, in the form of limestone, is the raw material from which the lime was originally produced. If lime can be economically reclaimed in a way to produce a satisfactory product for re-use in the softening process, a saving will accrue from this reclamation while bringing about a very substantial reduction in the volume of sludge to be disposed of as the irreducible minimum.

Reclamation Procedure

In softening waters containing little if any magnesium, the problem of reclaiming lime from the sludge, and its continued re-use in the treatment process, is relatively simple. The sludge as taken from the settling basins may be partially unwatered by some means such as a rotary vacuum filter or continuous centrifuge. The cake thus produced can then, without further drying be reburned in a calcining furnace of the rotary, multiple-hearth, or other satisfactory type. The product direct from the furnace is slaked (classified if need be to eliminate any undesirable grits) and the slurry re-used in the treatment process in the regular manner employed when using new lime. The carbon dioxide produced as the by-product is available for re-carbonation.

When using the lime-soda process for the treatment of waters high in magnesium, as in the case of Colorado River water which contains an average of 25 p.p.m. magnesium as Mg, this straightforward method of lime reclamation and reuse is not sat-

* Hoover and Montgomery, Consulting Engineers, Columbus, Ohio.
† Engineer, The Metropolitan Water District of Southern California, Los Angeles.
‡ For the first and second articles of this series—"I. Method of Treatment" and "II. Features of Plant Design" see Water Works and Sewerage for June and July, 1940.

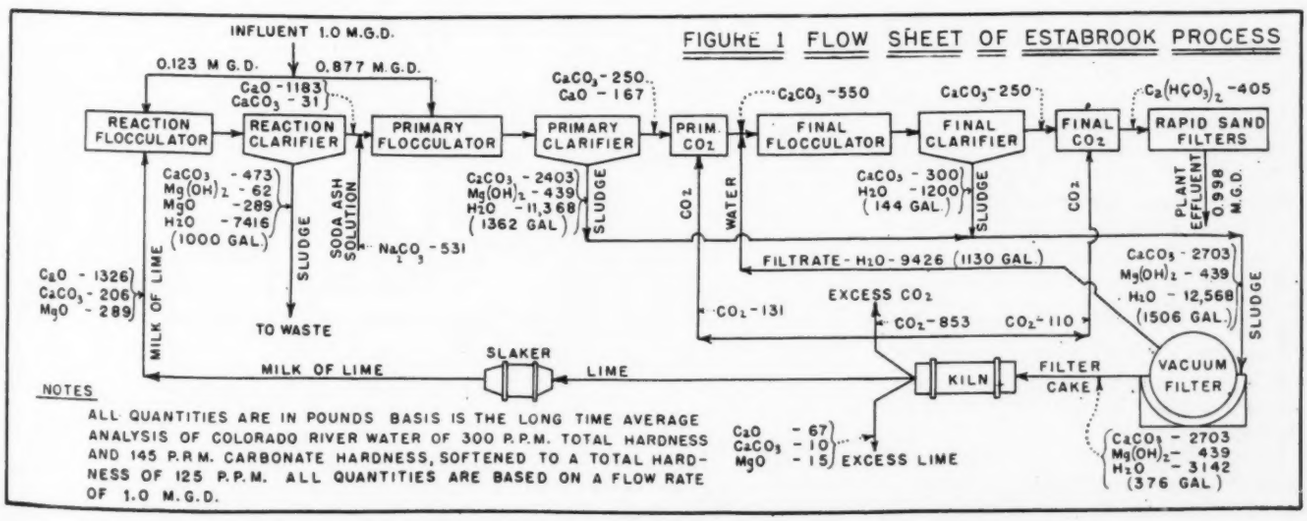
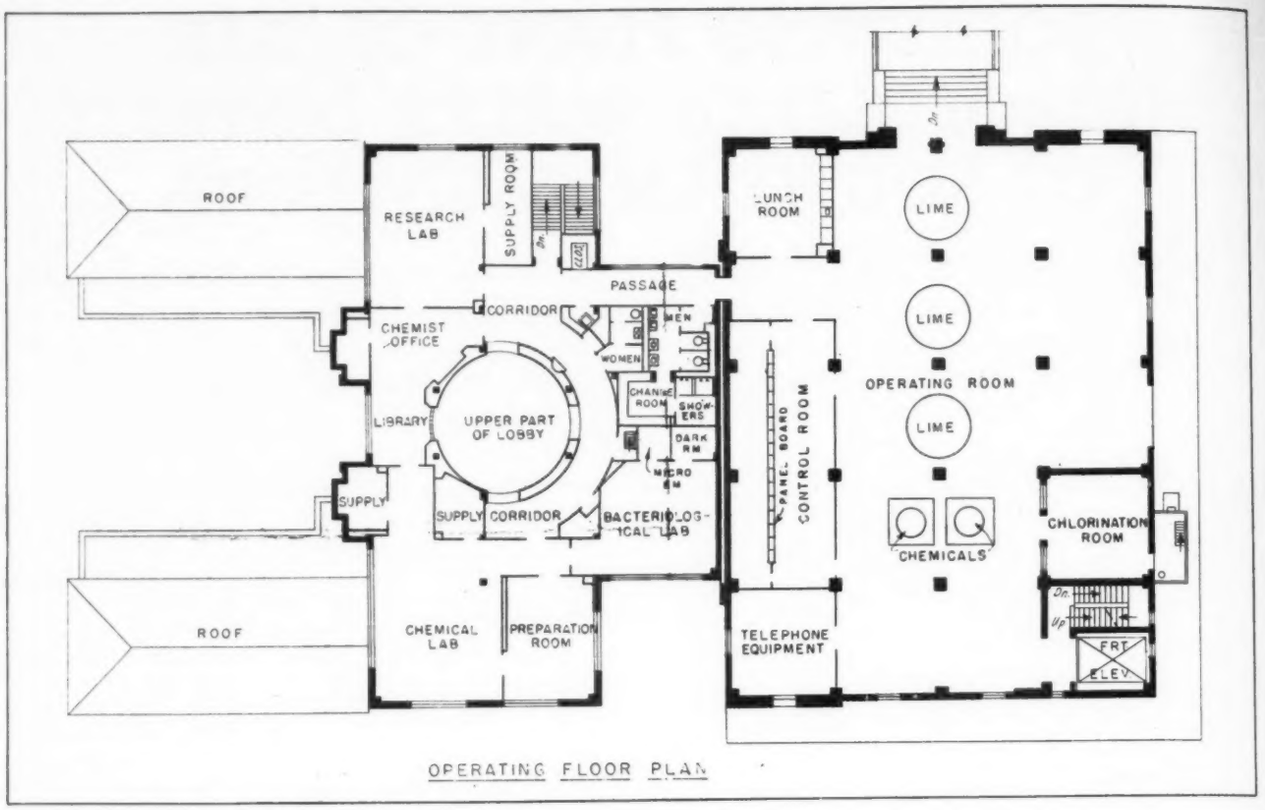
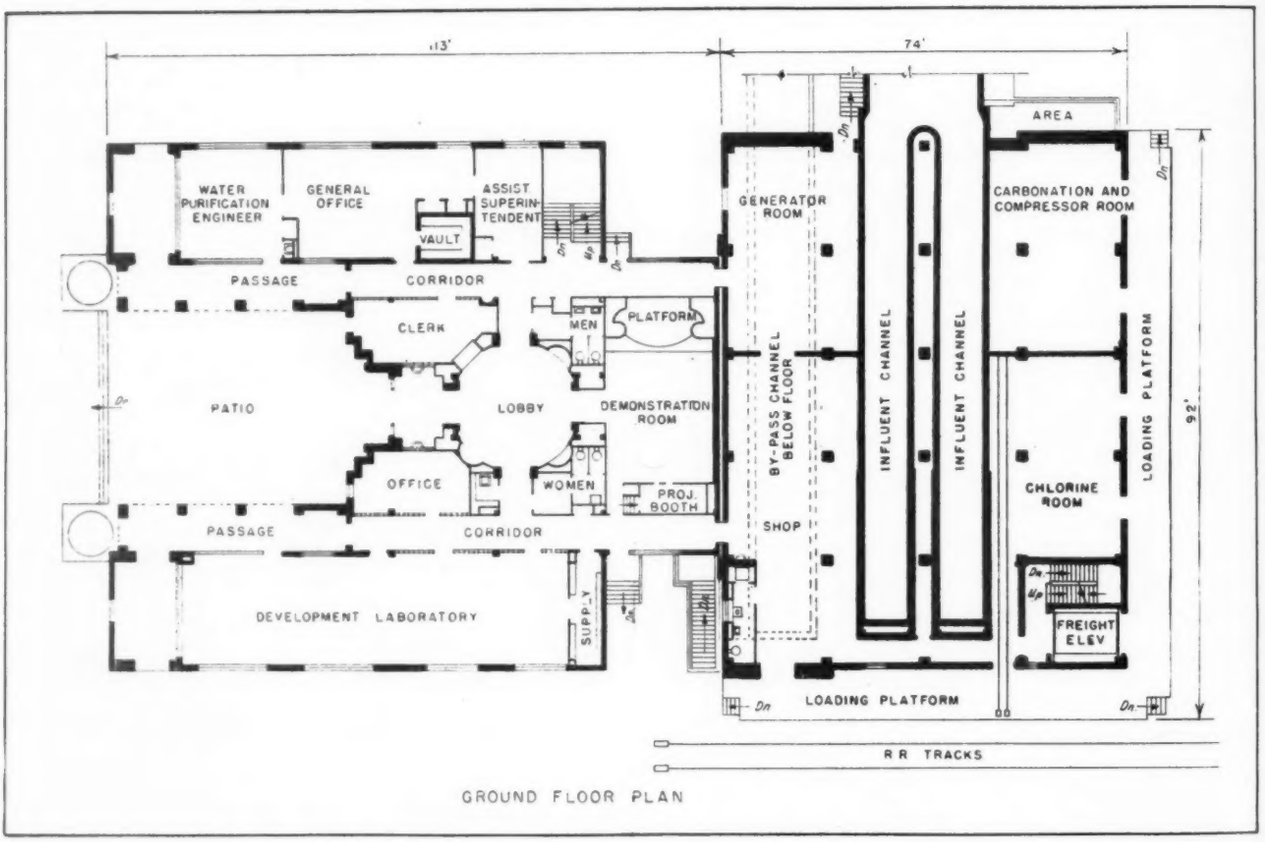


Fig. 1—Flow Sheet of the Estabrook Process of Lime Reclamation in Water Softening



Operating Floor



Ground Floor

Layout of the Head House and Administration Building of the Metropolitan Water District's Softening Plant

WATER WORKS & SEWERAGE, August, 1940

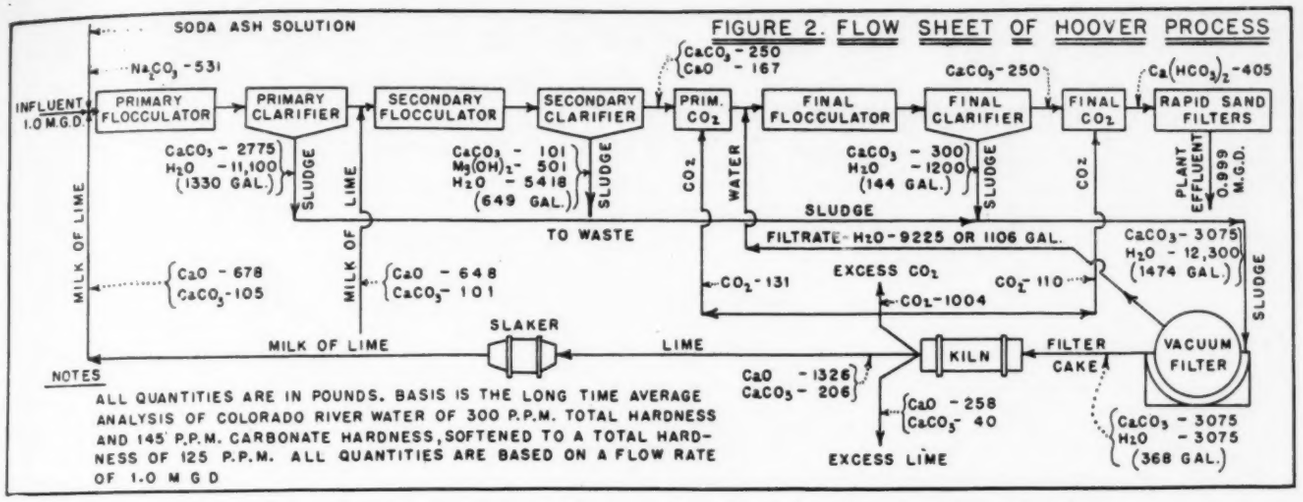


Fig. 2—Flow Sheet of the Hoover Process of Lime Reclamation in Water Softening

isfactory. Such is the case because the magnesium content of the reclaimed lime will increase to such an extent that the product eventually becomes unsuitable for use in the softening process. Any magnesium oxide (MgO) contained in lime, insofar as its value as a softening agent is concerned, is essentially so much inert material to be handled over and over again.

Three Methods of Avoiding Magnesia Build-Up

There are at least three methods, however, whereby magnesium build-up may be eliminated or held down to an extent that makes lime reclamation a feasible operating procedure. These are the Lykken-Estabrook process and the Hoover process, applicable in conjunction with the lime-soda method of treatment; and the lime-zeolite process.

The Lykken-Estabrook Process

The Lykken-Estabrook process (The Dorr Company, licensee), accomplishes this result by using a split treatment, adding the whole of the lime, required for softening all the water, to just sufficient water to put it into solution, settling the mixture, and then mixing this clear and essentially saturated lime water with the remainder of the water to be treated, together with any other chemicals which may be used. This process is most easily explained, and also readily visualized, by the flow diagram shown in *Fig. 1*. It will be noted that the sludge produced in the small (reaction) clarifier of the split process contains the magnesium hydroxide from softening this small amount of water in addition to the magnesium oxide present in the reclaimed lime from the main plant. This sludge must be wholly wasted, or later it may be found to have some other value for its magnesium content. The sludge from the main plant, which is identical to plants of standard design, is dewatered and reburned to produce lime for re-use. In connection with the investigations made recently, the flow diagram in *Fig. 1* was worked out to show the sludge and lime production from a typical plant of 1 m.g.d. capacity, treating average Colorado River water. It has been assumed that the lime has a solubility of 1.31 grams of CaO per liter. It can be visualized by a study of this diagram that, under the conditions presented, there will be an excess of 67 pounds of CaO, produced per million gallons of water treated. That is to say this quantity is that which may be reclaimed in addition to that actually required in the treatment process day in and day out. Different hardness characteristics of the water will, of course, vary the lime dosage, vary the ratio of split flow required to dissolve the lime, and vary the amount of surplus (or possibly a deficiency) of CaO produced per cycle.

The Hoover Process

The Hoover process (developed by one of the authors of this article), was also developed to accomplish the elimination of the magnesium build-up but in a different manner—to wit, by adding just sufficient lime in the first stage to precipitate all of the calcium present in the bicarbonate form; then, in the second stage, adding the necessary additional lime to precipitate the magnesium. The third stage in the Hoover process is the same as the second stage of a standard plant —namely to precipitate essentially pure calcium carbonate in the final clarifier by the addition of carbon dioxide to the caustic effluent from the secondary stage in which the magnesium is thrown out. This process is best understood by studying the flow diagram in *Fig. 2*. This flow diagram has been developed through use of the same base data as employed in Fig. 1 for the Lykken-Estabrook process. Thereby the quantity and quality of sludge which will be produced can be equitably compared for the individual processes.

In the Hoover process, sludge from the primary and final clarifiers is used for reburning; the sludge from the secondary clarifier, containing a preponderance of the undesirable magnesium compounds, is wasted. It will be noted that that the amount of excess CaO theoretically procurable from the Hoover process is 258 pounds per million gallons of water treated, which is somewhat greater than that from the Estabrook process. It is also to be noted that the lime recovered is essentially free of magnesia.

Advantages of Lime-Zeolite Softening

The lime-zeolite process is particularly adaptable for use with Colorado River water because all bicarbonates present are in the form of calcium bicarbonate. In this process, just sufficient lime is added to remove the bicarbonate hardness, thus producing a very pure calcium carbonate sludge which can be reburned to a high quality lime. A sufficient portion of the lime-softened water is then further softened to zero by means of zeolite, to produce a final product of the desired hardness: In this way no magnesium is precipitated to be handled as sludge, but is removed by the zeolite and carried away in the waste brine as magnesium chloride.

Figure 3 is a flow diagram for the

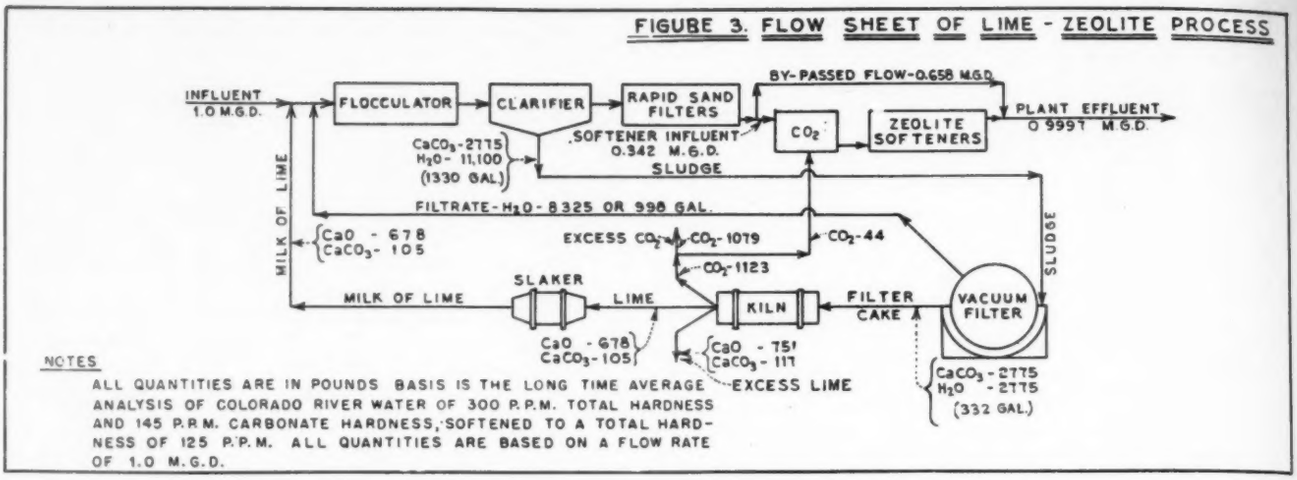


FIGURE 3. FLOW SHEET OF LIME - ZEOLITE PROCESS
INFLUENT 1.0 M.G.D.
FLOCCULATOR
CLARIFIER
RAPID SAND FILTERS
BY-PASSED FLOW-0.658 M.G.D.
PLANT EFFLUENT 0.9997 M.G.D.
ZEOLITE SOFTENERS
CO2
SOFTENER INFLUENT 0.342 M.G.D.
CaCO3-2775 H2O- 11,100 (1330 GAL.)
SLUDGE
FILTRATE-H2O-8325 OR 998 GAL.
MILK OF LIME
CaO - 678 CaCO3- 105
EXCESS CO2
CO2-1079
CO2-44
CO2-1123
SLAKER
MILK OF LIME
LIME
KILN
FILTER CAKE
VACUUM FILTER
CaO - 678 CaCO3-105
CaO - 751 CaCO3 - 111
EXCESS LIME
CaCO3-2775 H2O - 2775 (332 GAL.)
NOTES
ALL QUANTITIES ARE IN POUNDS BASIS IS THE LONG TIME AVERAGE ANALYSIS OF COLORADO RIVER WATER OF 300 P.P.M. TOTAL HARDNESS AND 145 P.P.M. CARBONATE HARDNESS, SOFTENED TO A TOTAL HARDNESS OF 125 P.P.M. ALL QUANTITIES ARE BASED ON A FLOW RATE OF 1.0 M.G.D.

Fig. 3—Flow Sheet of the Lime Zeolite Process in Respect to Its Bearing on Reclamation

(Note the simplification of stages of the process and fewness of units involved, when compared to those required when magnesia is precipitated with lime rather than being removed by use of zeolite.)

lime-zeolite process, prepared for comparative study with *Figs. 1 and 2*. Since for every pound of lime added to the water to remove bicarbonate hardness, enough calcium carbonate is produced to theoretically make two pounds of lime when calcined. Therefore there will always be either an excess of sludge; or, if all the sludge is reburned, an excess (surplus) of lime to dispose of. In many cases this excess lime can be used in adjacent sewage or industrial waste treatment works, or for other municipal purposes. Or it can be marketed as agricultural lime in contiguous territory.

The feasibility of lime reclamation and the method to apply can be determined only by a detailed study of the local conditions such as quality of water, plant location, ease and facilities of sludge disposal, marketability or uses for surplus lime, cost of chemicals, and method of treatment. In determining the cost of reclamation, investigations must be made of the rate of filtering or centrifuging the sludge. The filter rate may vary within such wide limits as from 50 pounds per square foot per 24 hours to 1,000 pounds per square foot per 24 hours, depending upon the magnesium content, the temperature, and the amount of moisture in the sludge going to the filter. This rate will, of course, affect the cost of filtering equipment requisite to keep the furnace operating on an even keel.

Lime reclamation is not new in industry, it is only new in the waterworks field. Almost all paper mills reclaim the lime in their causticising process, which is an identical procedure to that used in a water softening plant. Sugar mills in many cases reburn the calcium carbonate sludge to furnish part of their lime supply. The proposal of lime reclamation in the water softening plant is therefore not a radical one, nor is it an unexplored venture. It becomes merely the adapting of known satisfactory methods to do the desired job.

The Calcining Furnace

The calcining of the dewatered calcium carbonate sludge cake may be satisfactorily accomplished in either a rotary kiln or a multiple-hearth furnace. The rotary kiln has been used for many years for this purpose, while the multiple-hearth furnace is less well known in lime burning. It has been used very successfully in the ore roasting field, and more recently for incineration of sewage sludges and garbage. It probably will develop into a satisfactory machine for lime calcining. There is some indication that the fuel consumption of a multiple-hearth furnace is less per ton of output than that for the rotary kiln, but recent lengthening of the rotary kilns, together with the introducion of chain systems within the kiln, have greatly increased their efficiency.

In determining the economic feasibility of reclaiming lime from the sludge produced, many factors must be taken into consideration. Primary, of course, is the cost of commercial lime and the difficulty of obtaining sufficient suitable area for sludge disposal. In addition, such items as the value of that portion of the carbon dioxide produced that can be used in the plant, the cost of sludge handling, and the cost of producing the reclaimed lime when the reburning plant is operating at various load factors, must be included. In most cases, where the reburning plant operates above 50 to 70 per cent load factor, lime reclamation will probably prove economically feasible; while if it operates below that load factor, the purchase of commercial lime will most likely prove more economical.

When the final considerations of lime reclamation were investigated for the new water softening and filtration plant of The Metropolitan Water District of Southern California the last named condition proved the outcome. According to the then prevailing price for commercial lime, it would have been cheaper for the District to reburn the sludge from the start of operations. However, one of the nearby cement companies submitted a bid for lime on a five-year contract which was just about one-half the prevailing price. Investigations indicated that during this five-year period, when the water demand on the softening plant would be relatively small to start with and gradually increasing, it would be cheaper to buy the commercial lime than to reburn the sludge, and likely more practicable. After the softening plant is operating above a rate of about 50 million gallons per day, it will then be economically desirable and wholly practical to institute the reburning of sludge to produce the lime required for the process.

This concludes the series of three articles describing the new plant of The Metropolitan Water District of Southern California, the method of treatment to be employed and the question of lime reclamation as an economic procedure plus a method of partially solving the sludge disposal problem.

SEWAGE FILTRATION WITH SILICA SAND FILTERS

Part 1—The First of a Series of Three Articles

By PHILIP B. STREANDER
Consulting Engineer
NEW YORK, N. Y.

The author of this article, with several years of experience in the design of rapid sand water filters as a background, interested himself in the potentialities of rapid filtration in sewage treatment. He set about to develop a shallow bed sand filter for sewage, which was first described in his article appearing in the July, 1935, issue of this magazine.

Considerable has developed in the direction of filtration of sewages, effluents and trade wastes, since Mr. Streander's article appeared. With the purpose in mind of bringing up to date the developments in mechanical filtration in sewage treatment we have requested Mr. Streander to review and analyze these developments.

This article is the first of a three article series. The second will deal more specifically with shallow-bed sand filters which have been perfected during the past five years, and will include performance data. The third article constitutes an enlightening discussion of the part played by effluent filters in the economy of sewage and waste treatment and plant design and capital investment in treatment facilities.

The Author

FROM the time the writer first proposed silica sand for sewage filtration (WATER WORKS AND SEWAGE, July, 1935) considerable work has been done experimentally, as well as in actual plant installations. The filter proposed at that time was a modification of the Blaisdell type, consisting of traveling hollow rakes having perforations for the issuance of scouring water jets. These rakes were attached to a pressure manifold mounted inside of a casing or caisson, placed over the surface of the sand and moved mechanically over the filter bed. It was the thought that the combined mechanical action of the rakes and the hydraulic action of the water jets would most effectively loosen the solids lodged in the sand and thereby readily flushed out by an economical low velocity back-washing action inside of the casing. This prediction was based on the effective operation of this type of slow-sand filter washer in the water works field. However, in several installations made it was found that the mechanical and hydraulic action, while efficient in the major portion of the bed, did not reach down to the supporting screen or the sand immediately above it. Bacterial action developed in this portion of the filter, with the consequent development of slimes. This affected to a large extent the capacity and efficiency of the filter. When these difficulties developed the manufacturer made an extensive study of the causative factors which were followed by experiments with various methods of removing the most tenaciously held solids. Such study and experiments resulted in the development of the type of filter and mechanical cleaner now in successful operation at four sewage treatment plants.

W. C. Laughlin, inventor of the Magnetite Filter, during this same period also developed a mechanically cleaned silica sand filter that has been successfully filtering sewage and paper mill wastes. And, in Germany, a large installation of silica sand filter beds has also been made at the Wuppertal plant in the Wupper Sanitary District. This plant, however, is of the deep sand, hydraulic back-wash type and is described herein as it is of interest in showing the application of silica sand for sewage effluent filters. [In this connection mechanical sand filters of the type used in water filtration have been employed at three American sewage plants for some years, notably at the Grand Canyon, where the water is reclaimed for non-potable uses. At Denver, Colo., for sewage filtration alternate bids included Magnetite and orthodox deep sand filters.—ED.]

Size of Sand and Depth of Bed

In water filtration the solids removed have been assumed to be caught within the upper 3 or 4 inches of the bed, more or less within the limit of the effective size of the sand, this ranging between 0.40 and 0.60 m.m. Putting the major burden on the top of the bed alone is now questioned and it is held by many that the sand bed should be expected to remove solids throughout the major portion of its depth. However, where high removals, in both turbidity and bacteria, are required common practice in water filtration still places major dependability on the upper part of the bed for such removals. Further, water filters operate on losses of head which mount to 6 feet or more and the gelatinous substance formed over the bed by the coagulant serves as a membrane to prevent the passage of the turbid matter into and through the sand bed, at least so long as cracks do not form in this filtering matte. With such a conception of water filters, employing fine-grained media in deep beds, it can be readily seen that many difficulties would arise, were these to be adopted in an unmodified form to the filtration of sewage. In fact such difficulties have been experienced with deep bed filters. Water filters generally receive water having a turbidity of between 10 and possibly 50. However, it is

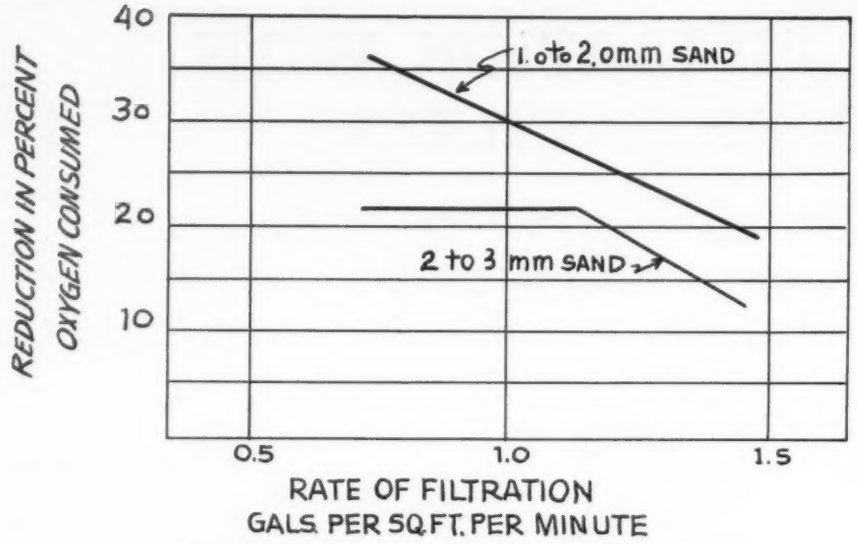


Fig. 1—Reductions in Oxygen Consumed Valves
(Wuppertal Experimental Filters)

important to realize that solids in water are largely mineral, whereas sewage filters must pass sewage having a turbidity up to 300 and suspended solids ranging between 50 and 200 p.p.m., all of which is predominantly organic and tenacious, greases and soaps being especially so. Under such a condition a water filter would quickly clog and become ineffective or would require an abnormal amount of wash water for its cleansing. In the deep bed which is difficult of proper cleansing putrefaction sets in and slime growth occurs.

From studies and observation made of the behavior of sewage filters, particularly in handling settled sewages, it is evident that solids are retained within practically the full depth of the bed, as compared to water filters where the solids are retained within the upper part of the bed. Under such conditions the sand required for sewage filters should be much more uniform in size than for water filters and of such size as not to clog quickly. This holds true for both the shallow bed mechanically cleaned filter and the deep bed (back-wash type) filter. The range in sand size is quite important, a small range with increased size of pores, has given more uniform operation and a capacity for retaining more solids between cleansings. How narrow this sand size range should be has not as yet been definitely determined. Such is influenced, to some extent, by the pre-treatment given the sewage (chemical precipitation, biological flocculation, or plain settling), and the amount of solids to be removed and the limitations of wash water requirements.

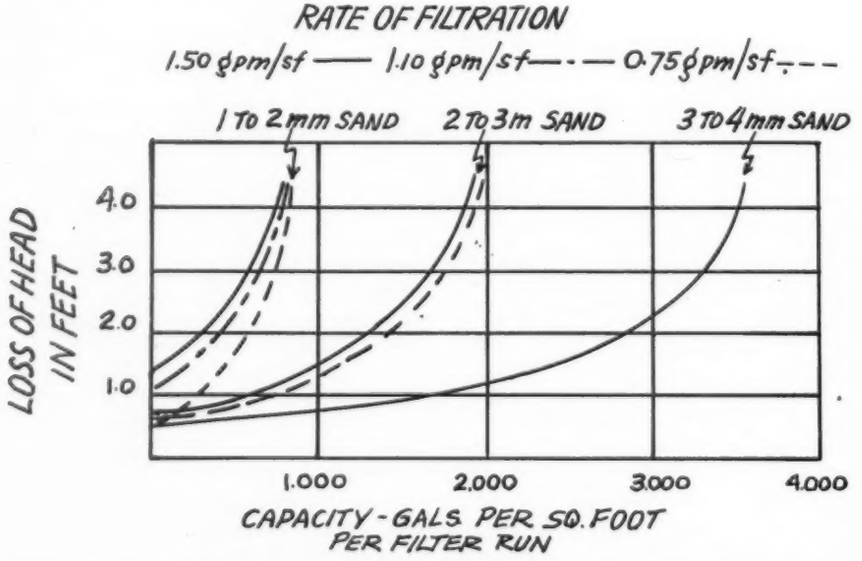


Fig. 2—Filter Capacity Per Run With Various Sand Sizes
(Wuppertal Experimental Filters)

Why Shallow Bed Units?

The thickness of shallow bed, mechanically cleaned filters is determined largely by the ability of the cleaning mechanism to effectively and quickly flush the retained sewage solids from the sand. Depths of filters used in existing plants, with the two types of washing mechanisms now in use for cleaning silica-sand beds, have on the average been only 6 inches. It is believed that this represents the minimum depth for silica-sand beds, if uniform operation is to be dependably secured. Maximum depth, with present washing equipment, probably cannot exceed 12 inches. However, further experimental work must be done at this depth before any definite conclusions can be drawn. Concerning the upper limit of depth for practical and most economical service.

The thickness of the deep-bed (back-wash type filters), is of course not limited by the cleaning mechanism, but is limited by their ability to operate uniformly at the higher losses of head common to such filters. This in turn is influenced and largely controlled by the loss of head through the filter.

Several installations of deep bed sand filters have been made in this country for the filtration of sewage effluents, among which are Bellefont, Pa., Grand Canyon, Col., Barrington, N. J., the latter plant having been designed by the writer in the year 1929-1930. These filters, however, followed conventional water works practice, having rate controllers and gauges for loss of head and rate of flow. They followed trickling filter and activated sludge treatment and the filter loadings were but little, if any, in excess of those common to water filtration plants. No deep bed sand filters have been installed in this country for the filtration of plain, settled or flocculated sewages, nor have any experiments been made thereon. For the purpose of this discussion recourse is therefore made to experiments made at the Wuppertal plant in Germany, where the subject of deep sand filter beds was given thorough study and test prior to the actual building of the full size filters.

Deep-Bed Filters of Wuppertal

Three sizes of sand and three depths of bed were used in the Wuppertal experimental filter, which was arranged to utilize positive head up to a maximum loss of about 4 feet. The results were tabulated to reveal reductions of oxygen consumed value and clarity of the effluent. A very

coarse sand (3 to 4 m.m.), operated 40 to 50 hours between washings, but its efficiency was low. At 12-in. depth the beds acted irregularly; at 28-in. depth it worked more evenly, but did not reduce the oxygen consumed more than 12%. Using 2 to 3 m.m. the 12-in. depth of bed proved the more practical and effective overall. The filter was operated at rates corresponding to 0.75, 1.10 and 1.5 gallons per square foot per minute. The reduction in oxygen consumed was 12% at the higher rate and 21% at the lower rate. The loss of head increased to a maximum of 3.9 feet after the passage of about 1,800 gals. for each square foot of bed. The runs between cleansings were 20 to 25 hours.

The third experiment was conducted using 1 to 2 m.m. sand. With sand of this size the 28-in. deep beds gave more uniform and more consistent results than the 12-in. and 20-in. deep beds. The reduction in oxygen consumed varied with the rate of flow through the filter, being 20% for the 1.50 gal. rate, 25 to 30% for the 1.10 gal. rate and 35% for the 0.75 gal. rate. After a run of only 8 hours the loss of head reached the maximum of 3.9 feet with the passage of about 800 gals. for each square foot when the rate was 1.5 gals./min./sq. ft. At the 0.75 gal. rate the length of run evens up to 16 hours. [Note that the same quantity of sewage was filtered in each instance, the time being doubled with the half rate prevailing.]

During the experiments it was demonstrated that the retained solids were well distributed from top to bottom of the bed. It was indicated by settling samples of unfiltered and filtered sewage and waste wash water that the solids retained within the sand voids represented about 70% of the total volume of voids. The removal of suspended solids at the 0.75 gal. rate, using 1 to 2 m.m. sand was between 80 and 90% of that possible with laboratory paper filters. Based on the experimental findings (Fig. 1 and 2) ten (10) large deep-bed backwash type filters were installed in the Wuppertal plant, which are further described herein.

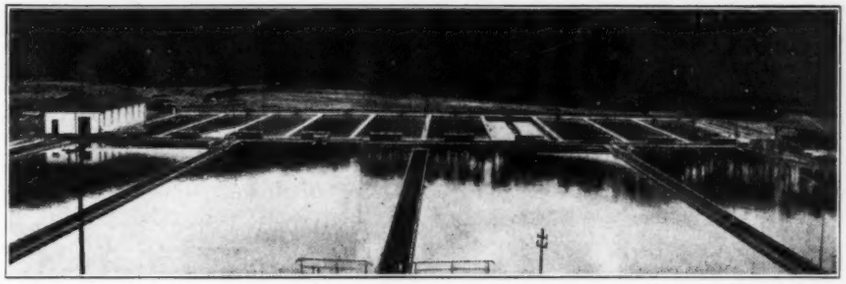


Fig. 4—The Wuppertal Plant in Germany
(Settling Basins in Foreground and Deep Bed Air-Wash Sand Filters in Background. —See sectional sketches for details of design.)

Cleaning of Sand Bed

Almost of equal importance to the size of filter media and the depth of the bed, comes the cleanliness of the bed and how to maintain such. This prime requisite is now receiving considerable attention even in water works practice, where it is being proven that far better results can be secured by maintaining a thoroughly cleaned filter bed. Prior to the advent of high velocity wash, combinations of mechanical rakes and low velocity back-wash, or air agitation followed by water wash, maintained the sand in a comparatively clean condition. Later, reliance was placed on the high velocity back-wash (high sand expansion) to remove the accumulated solids. It has, however, been proved in practice that high rate backwashing, irrespective of the effectiveness of the distribution system and volume of flow, has not produced an absolutely clean sand bed. To overcome this deficiency various types of fixed and rotary types of surface jet-agitators have been developed. With some of these it is indicated that materially better sand cleaning results, with consequent increases in filter rates and length of filter runs permitted. In addition the effluent is of a higher quality.

The same conditions hold true for sewage filters as for water filters, but to a greater extent. Sewage solids, as previously stated, decompose rapidly and result in bacterial slimes that tend to rapidly clog the sand bed and the supporting screen system. At the Wuppertal plant (deep beds), all of the sewage solids were not removed from the bed, as indicated by the amount of solids remaining in the wash water at the end of the filter run. At the commencement of the washing the suspended solids averaged 20,000 p.p.m. and at the end averaged 1,000 p.p.m. It was reported that this did not affect the operation of the filter, However, time alone will answer this question and the writer's

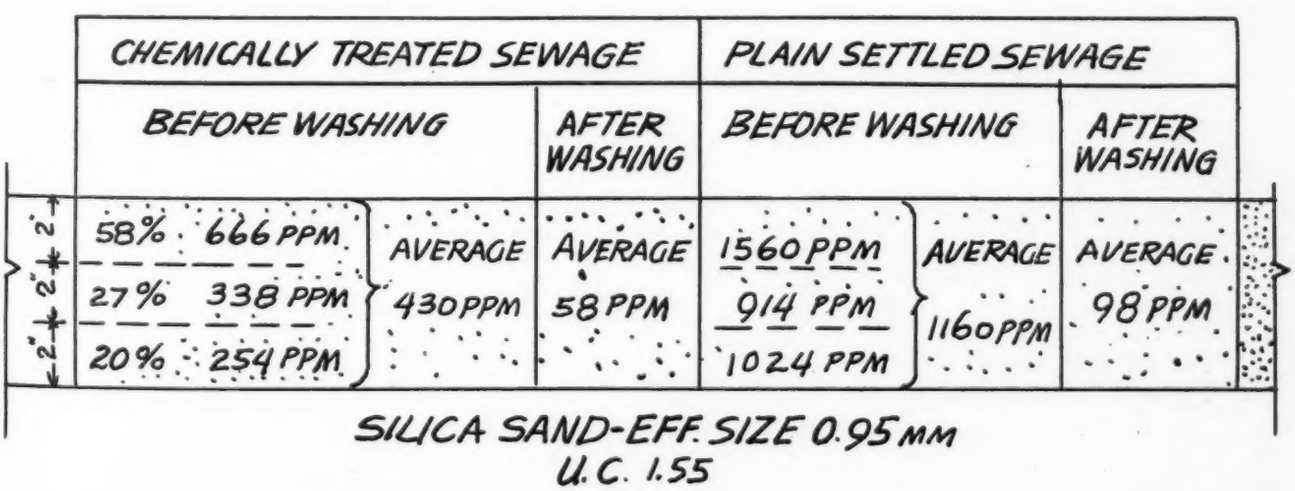


Fig. 3—Distribution of Retained Solids in Shallow Sand Filters
(From Studies With Chemically Precipitated and Plain Settled Sewage)

experience leads him to predict difficulties.

In the washing of shallow bed filters it is clearly indicated that thorough cleaning of the sand materially improves the efficiency of the filter. This was demonstrated at several plants in the Raritan River Valley of New Jersey, where the cleaning mechanism originally installed did not thoroughly clean the full cross section of the bed. At the time, no measurements were made of the efficiency of the cleaning mechanism, but observation of the sand showed that, after cleaning, some solids remained in the lower portion of the bed. As a result filtering rates through the bed were not uniform, nor could consistent and comparative results be secured over any extended period of time. The efficiency of the filter was low, irrespective of the rates of filtration or size of sand used. When an improved sand cleaning mechanism was installed these filters acted more uniformly and averaged a removal of about 50% of the applied solids. This indicated that thorough cleaning of the *complete* depth of sand bed was essential for efficient filtration through shallow filter beds. In this particular instance the sand cleaning mechanism consisted of a traveling row of sand eductors on an arm, very similar to a hoe-type grain drill in appearance. Through these eductors the said was forced by means of hydraulic jets, thereby giving the sand a thorough scrubbing and effecting a high removal of retained solids. The effectiveness of this washing is shown in Fig. 3, where there is shown the distribution of retained solids on the bed. The results cover chemically treated and plain settled sewage, before and after bed washing. The sand cleaner showed an efficiency in the removal of retained solids, averaging between 85 and 90%.

The cleaning of the sand in shallow and deep filter beds cannot be compared directly as the cleaning operations are entirely different. In

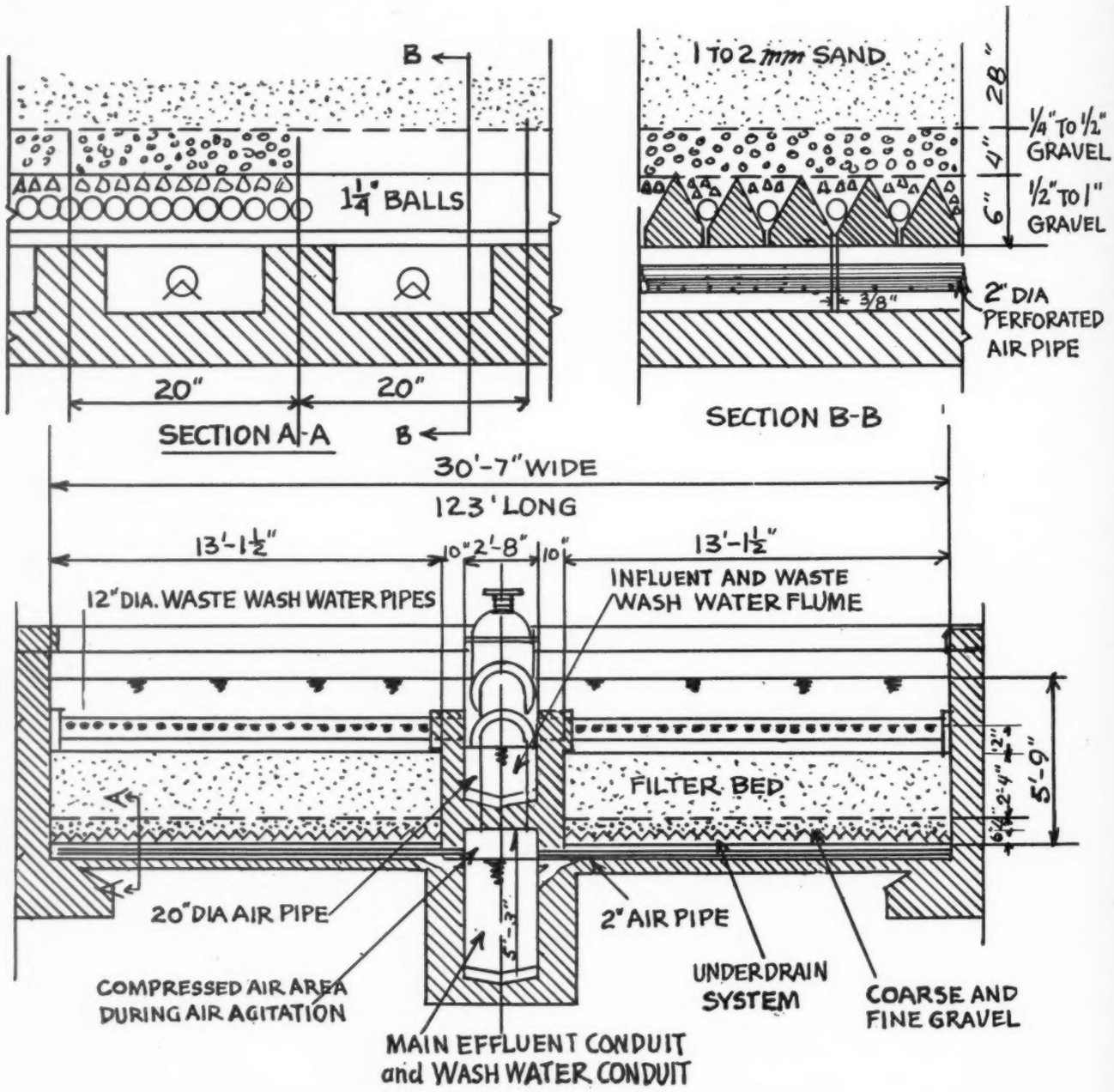


Fig. 5—A Section Through One of the Wuppertal Sewage Filters
(Note False Bottom Design and Air-Wash Scheme)

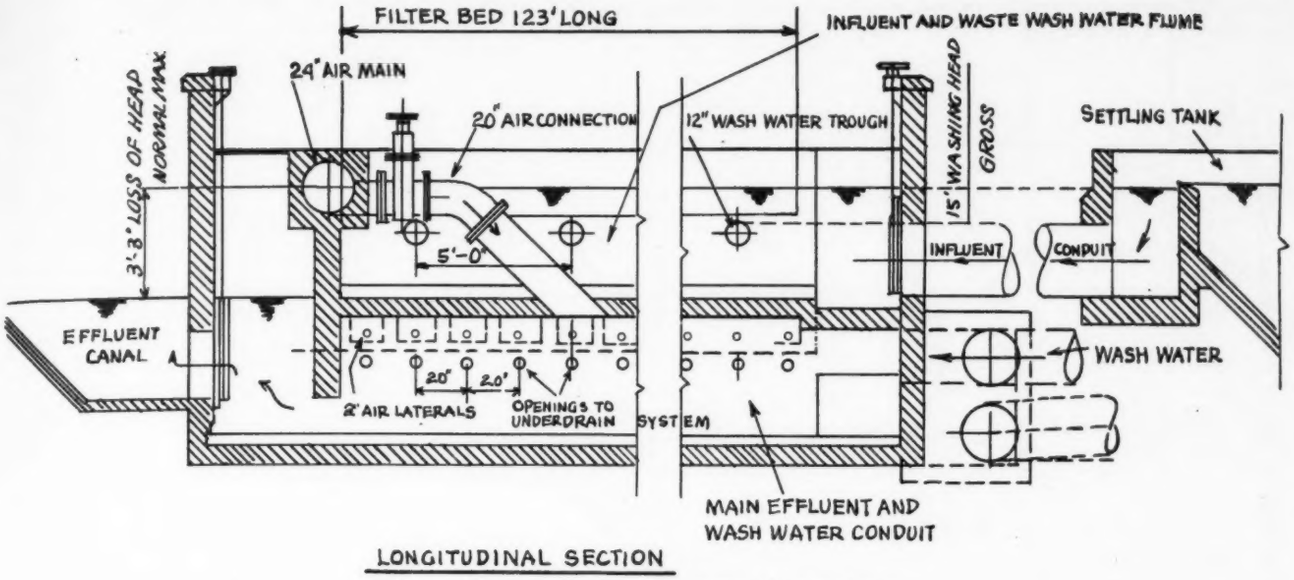


Fig. 6—Longitudinal Section of Wuppertal Filters
(Note Sparsity of Valving and Simplicity of Piping)

deep bed filters, having a greater accumulation of solids due to longer filter runs, the washing period may vary between 15 and 20 minutes, depending on the amount of solids retained in the bed, and their physical characteristics. Further the cleaning period can be extended as long as is necessary to remove these solids. On the other hand, in shallow beds the cleaning is effected by passing the cleaning mechanism just *once* through the bed at a certain rate of speed and, thereafter, its return across the same area as a cyclic scheduled operation. This means that the retained solids *must* be removed in a comparatively short period of time, if at all. In one type of cleaner the effective washing time is only about 18 seconds at each pass, as determined by the travel rate. In such a short time it can be readily seen that to secure efficient removal of retained solids the cleaning action must be much more violent than is required for the deep filter beds. No direct comparison can be made of the violence of the cleaning action in the two types of beds as no definite or accurate information is available covering deep bed sand filters.

Relative to the cleaning of filter beds it should be noted that the total weight of the suspended solids in the filter influent must equal the total of the solids in the effluent and the wash water. Further the weight of the suspended and retained solids entering the cleaner should equal the weight of those leaving the cleaner, both of which statements are self-evident. With a low cleaner efficiency the solids are not removed and sewage passing through the bed will drag these into the effluent, thereby lowering the efficiency of treatment. Likewise, certain portions of the bed become foul and inactive. It is, therefore, evident that high filter efficiencies can only be secured from shallow filters so long as the sand cleaning mechanism operates efficiently. This applies to deep filters as well, but no definite relation has been established between the solids remaining in the bed (after cleaning) and the efficiency of the filter.

Waste wash water, derived from the washing of the filter, contains heavy concentrations of suspended solids. These solids, however, are not similar to those entering the effluent filters. The latter are light and difficult to settle, but when later removed by washing are comparatively heavy and settle rapidly. This observation is not only interesting but has an important significance. This change is a physical one, being due to the packing of the solids within the beds whereby their shape and specific gravity are changed. Therefore, the waste wash water can always be returned to the settling tank influent for subsequent removal by settling and not travel through to the filter again. Such return is permissible since mechanically cleaned shallow bed filters use very low wash water rates as compared with deep sand filter beds.

Deep Sand Filter Beds of Wuppertal

The large scale installation of sewage effluent filters, referred to at Wuppertal, Germany, was completed in 1939 at the sewage treatment plant serving the Wupper District in Germany. Wuppertal, the principal city in the district, has a population of about 410,000, of which about 370,000 are connected to the sewer system. In addition to the domestic sewage large quantities of industrial wastes enter the sewer system, such as the waste from dye works, bleaching industries, artificial silk factories (using copper ammonia process), etc., which materially increases the flow of sewage to the plant. When designed it was anticipated that the flow to the plant would be 24 M.G.D. Due to the difficulty of treating sewage containing large quantities of industrial wastes, the experiments previously described were made on deep sand filter beds. While these tests were being conducted concurrent observations and tests were made of the results to be secured in the river based on receiving a filtered sewage. These indicated that the load on the river would be materially reduced by effluent filters and filter beds were therefore designed and constructed to serve the entire plant. It was intended to observe the actual effect of the filtered sewage on the river and after proper studies had been made, to decide whether or not an activated sludge plant would be required. It is of interest to note that the experimental work indicated that with filtered sewage the aeration period in an activated sludge plant could be reduced by about 50%.

The effluent filters installed, as shown on Fig. 4, consist of ten (10) units each 26 feet 3 inches wide by 123 feet long, this size being used to save the additional valves and piping that would have been required with a large number of smaller units. Based

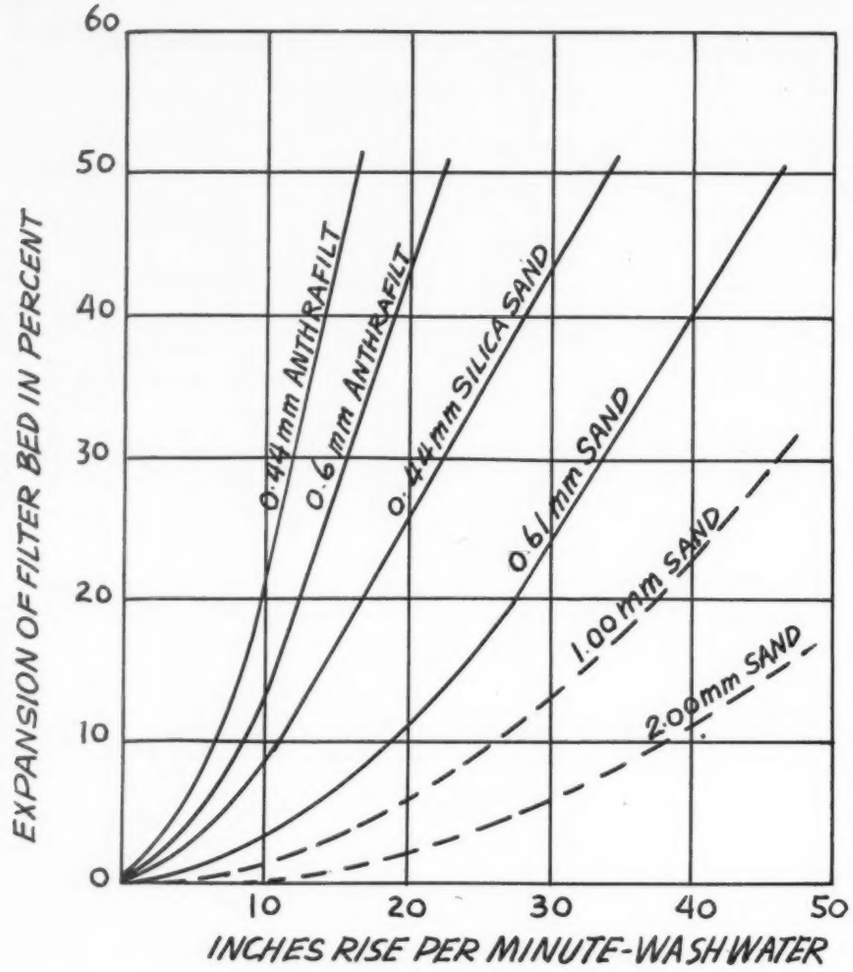


Fig. 7—Filter Bed Expansion Curves
(*Note that it takes a 27-in. vertical wash rate to secure only* 10% *bed expansion with* 1 *mm. sand and almost* 38 *in. with* 2 *m.m. sand.*)

on the experimental work it was concluded that the probable maximum filtering rate to be used was 0.83 gals. per square foot per minute. Making allowance for filters out of service, for washings and other contingencies, the area provided was based on a filter rate of 0.5 gals. per minute. The total area of each bed is 3,228 square feet, an area of 32,280 square feet total for the flow of 24.0 m.g.d. The beds as constructed have a central influent and waste wash water flume built over the effluent flume. The wash water troughs consist of 12-in. diameter Transite pipes with holes drilled in the upper part to remove the waste wash water.

The design of the filter is ingenious in many respects. The only iron and steel used is that in the gate valves and sluice gates and to provide simple control these were reduced to the minimum possible. Transite piping was used for practically all of the piping connections to and from the filters, and even for the air mains and laterals used for air agitation of the sand bed. The filter bed consists of 28 in. of sand, 1 m.m. to 2 m.m. in size, laid over 4 in. of coarse and fine gravel. The underdrain and wash water distribution system was patterned after the well known Wheeler filter bottom of many inverted pyramids filled with ceramic balls. A concrete floor with inverted concrete beams spaced on 20-in. centers (Fig. No. 5) formed the bottom of the bed on top of which triangular shaped precast concrete blocks were placed with the edge pointed upward. A ⅜-in. gap between the blocks forms a slotted opening to the pressure chamber under the blocks and between the beams. In the space between the inverted "V" shaped blocks, 1¼-in. unglazed porcelain balls were placed to support the coarse and fine gravel. Each chamber is connected to the main effluent and pressure water conduit by means of piping, as shown in Fig. 6.

Air-Wash Scheme

A 2-in. inside diameter Transite pipe, having porcelain nozzles, is laid in each pressure chamber, each pipe being extended to the main effluent and pressure conduit. The upper section of this conduit is used for distributing the air to each lateral, the air being supplied to this section through a valved air main as shown. Air is supplied by means of centrifugal blowers of a capacity sufficient to supply 2.4 cubic feet per minute per square foot of filter area. Settled sewage is used for backwashing the filters, the total head being that between the top of the waste wash water troughs and the level in the settling tank—i.e., about 15 in. The waste wash water is stored and pumped back to the treatment plant during the low night flows. The loss of head allowed through the filter during normal operation is 3.25 ft., but when the flow is small there is available a maximum head of 4.25 ft. As shown in Fig. 6 each filter is provided with a gate for flow regulation and the sewage flows from the filters in a conduit, placed under the filters, which is also provided with a gate for flow regulations.

In actual operation the settling tanks and the filters effect a total suspended solids removal of 60% as compared with 35% for settling alone. The filters remove about 40% of the solids remaining in the settled sewage. The flow reaching the plant is actually about 25% greater than anticipated and certain additional and required settling tanks were not constructed. On this account it was not possible to handle peak flows satisfactorily. It is suspected that the reasons for the comparatively low removals at such a low rate as 0.5 gal. /sq. ft./min., when compared to the results secured by the experimental unit, are due in a large extent to the inability to thoroughly remove the retained solids from the sand bed. It had been previously assumed that the reductions secured experimentally in oxygen consumed were due in part to chemical and biological reactions taking place within the sand bed. This may have been partly true in this instance, but undoubtedly greater removals and higher rates could have been secured in the experiments had the beds been thoroughly cleaned by mechanical or other means.

Unfortunately these suspicions cannot be verified at the present time, but an analyses of the experimental work and the design of the filters would indicate that while air agitation served to loosen the heavier solids, the rate of backwash in the experimental unit was only high enough to float these off and not high enough to remove the finer entrained solids or to thoroughly scrub the

sand. In the filters as built the perforated pipes used as wash water troughs were placed so that the perforations were about 12 in. above the level of the sand. Naturally, with such an arrangement the rate of backwash must be comparatively low so as to prevent loss of sand. It is indicated that with a properly designed wash water removal system, and with previous air agitation, the rate of backwash could have been materially increased with consequent improvement in the washing of the filter.

The rate of backwash in a deep sand filter bed is controlled largely by the size of the sand used in the bed. With a small size sand a low rate of backwash must be used and as the size of the sand increases the rate of backwash can be increased. This is graphically shown in Fig. 7 showing the relative expansions of silica sand and "anthrafilt" of 0.44 m.m. and 0.61 m.m. effective size. To this graph curves have been added for silica sand of 1.0 m.m. and 2.0 m.m. sizes. Referring to this figure it can be seen that backwash velocities of 30 to 40 in. per minute are required to expand 1.0 and 2.0 m.m. sand to as much as 10%. At the Wuppertal plant the backwash rate was about 6 to 8 in. vertical rise per minute. This undoubtedly accounts for the comparatively low filter efficiency, and the inability of the filters to properly handle peak rates of flow even at such low rates of filtration. It is believed that with properly designed deep sand filter beds, *having efficient and positive means of agitation* of the sand in the bed, and *effective removal of the waste wash water,* that filter rates of 1.5 to 2.0 or more gallons per square foot per minute can be used to secure removals of 70 to 80% of the solids contained in the filter influent.

[The second article in this series will describe and analyze filtration in shallow bed effluent filters, equipped with mechanical cleaners that have been developed for positive cleansing of shallow sand beds.]

Dignified Duty!

It was not too long ago that an elevated tank was just that and nothing more. They all looked more or less alike, were built to stand up, not to leak, to give service—but in our opinion *never to look at.*

Times have changed though and with the thoughts of water utility managements turned decidedly to improved public relations, along with better water service, goes the thought of better looking properties. So now it is that many water towers and elevated tanks have been built with not alone the idea of giving improved service to consumers, but to please their aesthetic and artistic side as well.

The accompanying picture well illustrates the thought and artistry that is now being put into water towers. We hardly believe that even the Mayor of Finnicy-ville would object to this graceful structure in his back yard—nor even looking at this view across the road from his front porch. He certainly would feel more secure as the result of the half million of its contents so close by. We feel sure too that his friends on the opposite side of town would soon be getting up a petition for one just like it in their neighborhood.

Since the invention of sheet cellophane manufacturers have learned that the way to sell things is to wrap them in attractive packages. From this, and other similar pictures on file, it is apparent that water tower manufacturers have taken a leaf from this book on the worth of putting out an attractive package, and are doing so. We are all for them in doing it, too, because we believe that all Finnicy-villes get their full money's worth when they buy water towers. And they might as well spend a few dollars more and get something pleasing to look at.

And a Certain Grace Has This Water Tower.

We believe, too, that the water utility, publicly or privately owned, is justified in paying the extra money which it may take to do so. This because there is no "sign-board" which can mean more to this utility than neatly painted hydrants and pleasing water towers, remembering that for the most part there is little additional that can more effectively remind the public of "what is behind the water spigot."

This particular tank has recently been erected for the City of Newburyport, Mass. It has a capacity of one-half million gallons, is 61.2 ft. in diameter and 25 ft. deep; is supported on an 83 ft. tower. Its happy proportions are right technically, symmetrically and architecturally. It is Newburyport's (pop. 15,000) second tank and was installed under a chairman of the Board of Water Commissioners who is a trained sanitary engineer. It is located in a high class residential district, such as have in years past strenuously objected to anything resembling the "ugly duckling" water tank of yester-year.

We captioned the picture of this tank—"Dignified Duty"—because of the service and safety function it performs for the community at all hours; and, with it all, possessing an impressive air of dignity in keeping with its neighborhood. As we have already said, Newburyport's tank serves as a noteworthy example of what is happening in the field of water-tower design and fabrication.

THE SEWAGE TREATMENT PROJECTS OF OSSINING, N. Y.

By JAMES C. HARDING
Consulting Engineer
NEW YORK CITY

THE Village of Ossining, New York, is located in Westchester County about twenty miles north of New York City. It has a frontage of approximately three miles on the east bank of the Hudson River. The population is 14,000, exclusive of the 3,000, or thereabouts, in Sing Sing Prison which has its own water supply and sewerage facilities. The community is largely residential. The water supply is derived from surface sources and the per capita consumption is 60 gallons per day.

The Hudson River receives the sewage and industrial wastes of a population estimated at 10,000,000. The New York State Health Department has for a number of years waged a campaign to clean up the river and several years ago notified communities discharging untreated sewage into it that they must install

The Author

treatment plants by January 1, 1940. Ossining, along with several other municipalities on the river, made application to the PWA in July 1938 for a grant to aid in the construction of its plant and upon approval of this request in October of the same year authorized the construction of the project.

The principal obstacles to be overcome in the design of the sewage treatment project were first, the topography of the Village which made the collection of sewage at one point for treatment economically unsound; second, the scarcity and high cost of plant sites; and third, the problem of avoiding the pumping of any considerable quantity of sewage as most of the population of the Village lives in areas from 100 to 400 feet elevation above the river.

Two Plants and Eight Contracts

The plan as finally adopted called for the construction of two plants. The main, or Water Street Plant, is situated in the northern section of the Village and cares for about 90 per cent of the population. The southern end of the Village is served by the Liberty Street Plant, which cares for the remaining 10 per cent. To have brought the sewage from the Liberty

Entrance to Ossining's Main Plant on Water Street

Street Plant to the main plant would have necessitated either pumping the sewage against a head of 165 feet or laying a subaqueous siphon line estimated to cost $85,000 or constructing a tunnel at $140,000. Each plant has its own intercepting and outfall sewers.

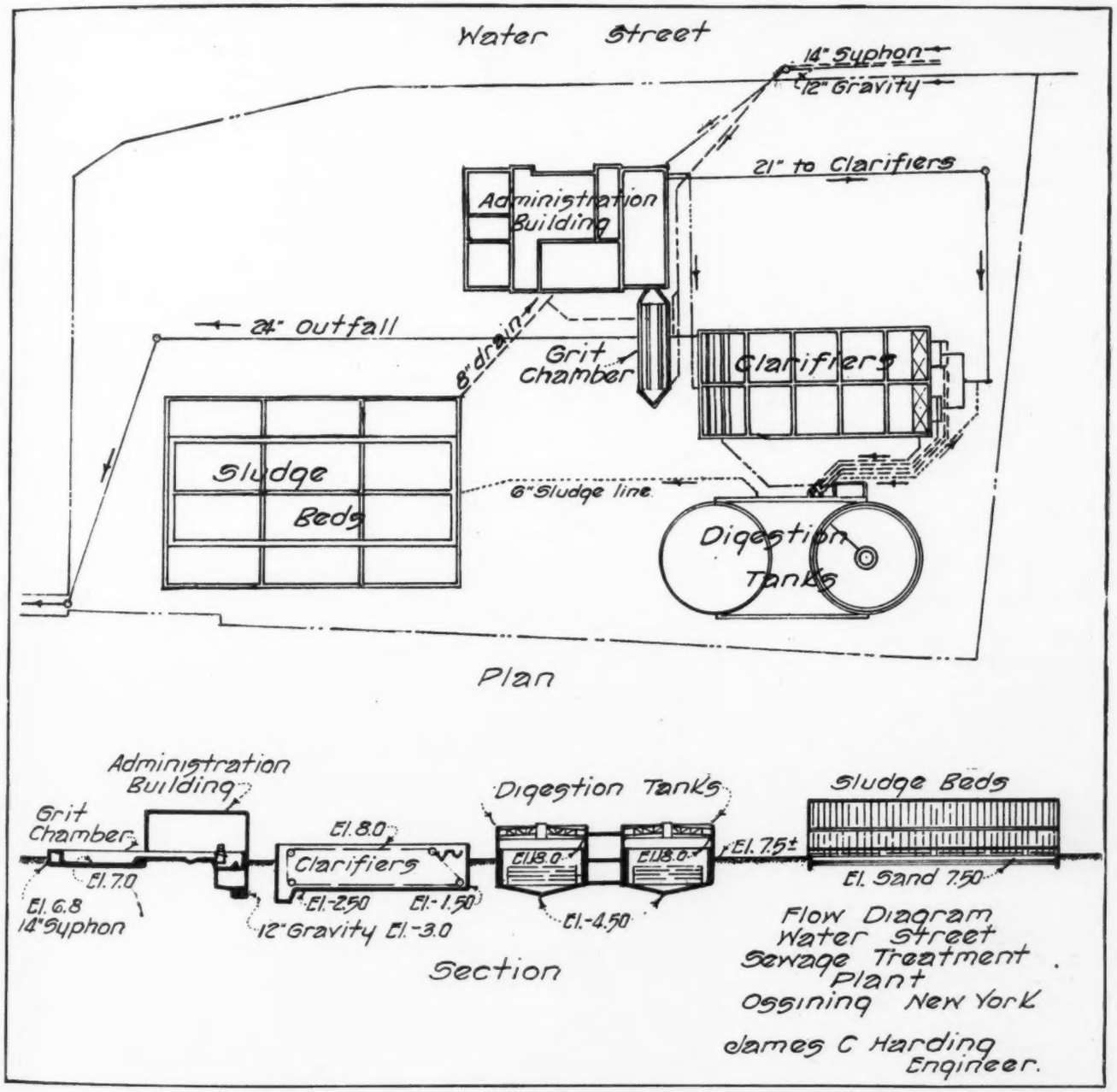
The sites selected are small and in built-up areas, however, they were well situated as far as existing sewer outlets were concerned and their cost was reasonable compared with other available locations. The pumping of all except approximately 10 per cent of the total sewage flow was avoided by the construction of inverted siphons.

Due to a desire to meet the PWA deadline as to completion date and to the belief that savings could be made by splitting the entire project up into several contracts, each of which could be handled by contractors skilled in the particular type of work involved, the project was subdivided into eight separate contracts. The contractors for the five major contracts were: Intercepting Sewers — DiMarco & Ciccone; Outfall Sewers—Spearin, Preston & Burrows; Liberty Street Plant—Dominick Corigliano; Water Street Plant —Robert Young Construction Corporation; Landscaping, Drives and Miscellaneous Work — Gasperini Construction Company.

Intercepting Sewers

The intercepting sewer for the Liberty Street Plant consists of a 10″ cast iron siphon line 535 feet long, diverting the sewage flow in the trunk sewer at an elevation of 24.50 feet and delivering it to the grit chamber of the plant at an elevation of 18.35 feet. The siphon line has a capacity of 1.4 m.g.d., but the overflow weir at the diversion manhole is set to by-pass storm flows in excess of 1.0 m.g.d.

The design of the intercepting sewers for the main plant was complicated. Although most of the Village lies at a high elevation there is a thickly built-up commercial district



Flow Diagram and Plan Sketch, Main Plant of Ossining, N. Y.

Insulated Sludge Digestors and Control House Between
(Note scum collection and quality of primary effluent from tank in foreground. See also interior view of sludge control room.)

along the river where the elevation is only a few feet above high water. Studies were made of several methods of bringing the sewage to the plant, but under the one adopted most of the sewage reaches the plant through inverted siphons and only that from the lower area is pumped. Although this method increased the first cost of the intercepting sewers very materially, it decreased the cost of the treatment plant because we were enabled to put in smaller pumps and wet well and, by reason of the fact that we only had to pump a small portion of the sewage, we could raise the elevation of the grit chambers and clarifiers and save money on excavation and foundations without worrying about increased power costs.

Siphon Line of Unique Construction

The siphon line is rather unique in that instead of the usual single inlet and outlet, there are four inlets and one outlet. The total length of the line including branches is 2,137 feet and the pipe sizes vary from 8″ to 14″. The maximum capacity of the siphon is 4 m.g.d., at which rate of flow the velocity is 5.8 feet per second.

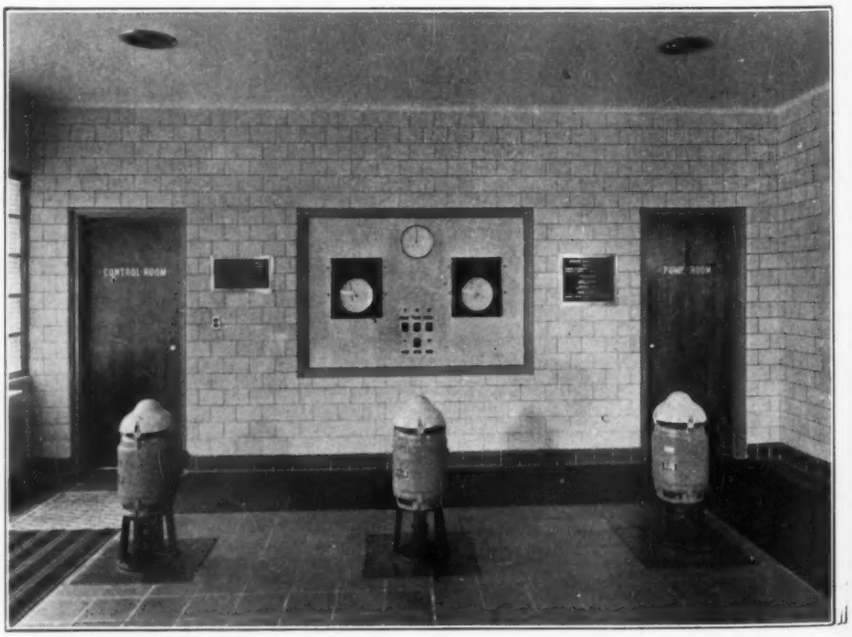
The main siphon line is constructed of enamel lined cast iron pipe and the branches are of Transite. A single line of pipe only was used instead of the convention two lines because ample head was available to get required maximum capacities and yet get cleaning velocities at minimum flows and also because we wished to avoid possible odor nuisances deemed likely to occur if a line full of septic sewage were discharged into the plant at the start of periods of high flow. All bends in the siphon line have removable hatch covers located in manholes. Taps are provided to permit flushing with a fire hose and blow-offs allow any portion of the line to be readily dewatered. Provision is made at the intercepting manholes for discharging storm flows over diversion weirs into the river, when in excess of 4 m.g.d.

The gravity sewer line has a maximum capacity of 1 m.g.d. and is constructed of 12″ vitrified pipe laid in a concrete envelope in the same trench with the siphon line.

Water Street Treatment Plant

The area of the Water Street Plant site is one and one-half acres and is rather small for a two million gallon treatment plant, particularly when it is desired to provide room for future additions and to keep certain units away from the street. It was necessary, therefore, to design the plant to be as compact as possible. The section immediately surrounding the plant is largely commercial but there are residences within 400 feet and a yacht club within 200 feet. The close proximity of buildings lead to taking every precaution to prevent odor nuisance and to making the structures and grounds attractive. As the ground elevation is only 7 feet above high tide all tanks were kept as high as feasible above ground to avoid expensive foundations and, in the case of the digestors, to minimize heat losses.

As previously stated about 80 per cent of the sewage is brought to the plant by an inverted siphon and 20 per cent through a gravity sewer from which the sewage is pumped at the plant into the siphon line. The incoming sewage is chlorinated just as it leaves the siphon, then passes through grit chambers, Parshall flume, comminutor and clarifiers, and out through a 24″ concrete pipe to the submarine outfall sewer. Sludge is pumped from the clarifiers to either one of two floating cover type digestors. The supernatant is returned to the inlet of the clarifiers and the digested sludge is drawn to glass covered sludge beds.



Pump Room and Metering Instruments

Chlorination

The sewage is both disinfected and deodorized by pre-chlorinating, the dosage being approximately 12 p.p.m., which has been found sufficient even under summer conditions to maintain a residual of more than 0.5 p.p.m. in the final effluent. It is intended to chlorinate only during the bathing season unless it becomes necessary at other times for odor control. Use was made of an existing Village owned Pardee chlorinator, but a new Toledo scale capable of accommodating two one-ton chlorine containers was purchased. This equipment is housed in a separate room in the administration building, which room can only be entered from an outsde door. A window looking into the motor room enables the operator to read his scales and check the performance of the chlorinator without going into the chlorine room. A hand operated hoist and monorail facilitates the unloading, storing and handling of the chlorine cylinders. A "drowning tank" was constructed underneath the monorail in which leaky containers can be dropped and the escaping chlorine absorbed by lime slurry.

Grit Chambers

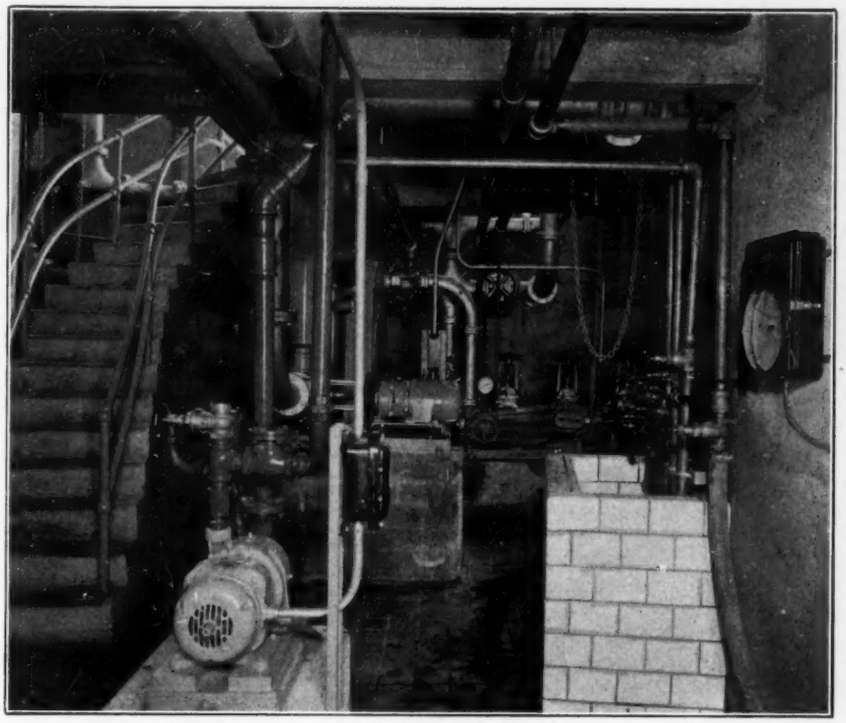
Duplicate hand cleaned grit chambers operate in parallel and provide velocities of from 0.85 to 1.06 ft. per second at flows of 1.5 to 5.0 m.g.d. The same trolley and hoist used for handling chlorine cylinders can also be used for grit removal. There is very little grit in the sewage as is evidenced by the fact that in the first month of operation, it was only necessary to clean a single chamber once.

Sewage Metering Equipment

A 6″ Parshall flume measures the sewage pumped from the gravity sewer and a 12″ flume, located between the grit chambers and the comminutor, measures the total flow through the plant. Float tubes placed beside the flumes are connected with Simplex recording meters mounted on the switchboard in the control room.

Comminutor

A 25″ Chicago Pump Company comminutor with ⅜″ slots is located between the flume and the clarifiers. An auxiliary bar screen is provided in the event that the comminutor is shut down. The comminutor operates continuously and to date has done a very good job of cutting up the larger solids.



Sludge Control Chamber Between Digestors

(*Note sludge and supernatant sampling arrangement on right. Flexibility of sludge handling emphasized in pump and piping arrangements.*)

Clarifiers

The clarifiers are of the rectangular type equipped with Link-Belt scrapers and divided into two units each, 72 feet long, 16 feet wide and with an average depth of 10 feet. The detention period at 2 m.g.d. is 2.07 hours. Inlet piping has been specially arranged to divide the flow equally between the two tanks and also between the two inlet pipes of each tank. For this purpose double branch ells were used. Distribution of the sewage flow evenly across the tank is aided by a concrete inlet baffle, most of the sewage passing underneath but enough going over the top to prevent the collection of scum at this point.

An outlet trough, with weirs on both sides, removes the clarified sewage. A concrete scum trough, set with its lip about 1″ above the normal flow line, is used for scum removal. Scum is scraped into this trough by hand. An unusual feature of the clarifiers is that there are no sludge removal valves provided at the tanks. These valves are located in the digestor building adjacent to the sludge pumps, separate lines being run an average of 60 feet from each hopper.

Incomplete records available to date indicate that the suspended solids in the incoming sewage are about 270 p.p.m. and are reduced to 70 p.p.m. during passage through the clarifier.

Digestors

There are two digestion tanks, each provided with Downes floating covers, supplied by Pacific Flush Tank Co. They are 34 feet in diameter and 22.5 feet in depth at the center of the hopper. The total effective capacity of both digestors is 35,300 cubic feet equal to 2.52 cubic feet per capita on a population of 14,000. The outer walls of the digestors above grade are insulated with 2″ of mineral cork made by Johns-Manville and are faced with the same brick used for the administration building. The roof is insulated with 1″ fibre board.

Instead of the conventional small chamber recessed in the center of the two digestors, the brick facing of the digestors is carried across to form a control building having the same depth as the diameter of the digestors and with a minimum width of 12 feet. In this building are placed all sludge piping and valves, the sludge pumps, heating equipment for both the digestors and the administration building, lime feed machine, etc. A feature of the digestor control building is the fact that the operator can control all sludge pumping and decanting from a single point. All of the control valves for raw sludge, digested sludge, and supernatant, are located a few feet from the sludge pumps as are also the sampling sinks

and tell-tales showing the elevation of the floating covers.

There are two sludge pumps, one a Chicago "Scru-peller" and one a Carter plunger type. Each of these pumps has a maximum capacity of 70 g.p.m., which capacity can be varied, the "Scru-peller" pump being equipped with a Vari-drive and the Carter pump with an adjustable stroke.

Sludge Handling Flexibility Stressed

Sludge and supernatant piping has been cross-connected so that maximum flexibility is obtainable. Raw sludge can be pumped from the clarifiers to the conditioning tank or from the clarifiers or conditioning tank to either digestor. Digested or digesting sludge can be re-circulated in either tank, transferred from one tank to another, pumped to the conditioning tank or to the sludge beds. Supernatant liquid can be transferred from one tank to another and can be used to flush sludge lines by gravity or with the use of the jet pump, and also can be used for breaking scum. The tanks may be operated either in series or parallel.

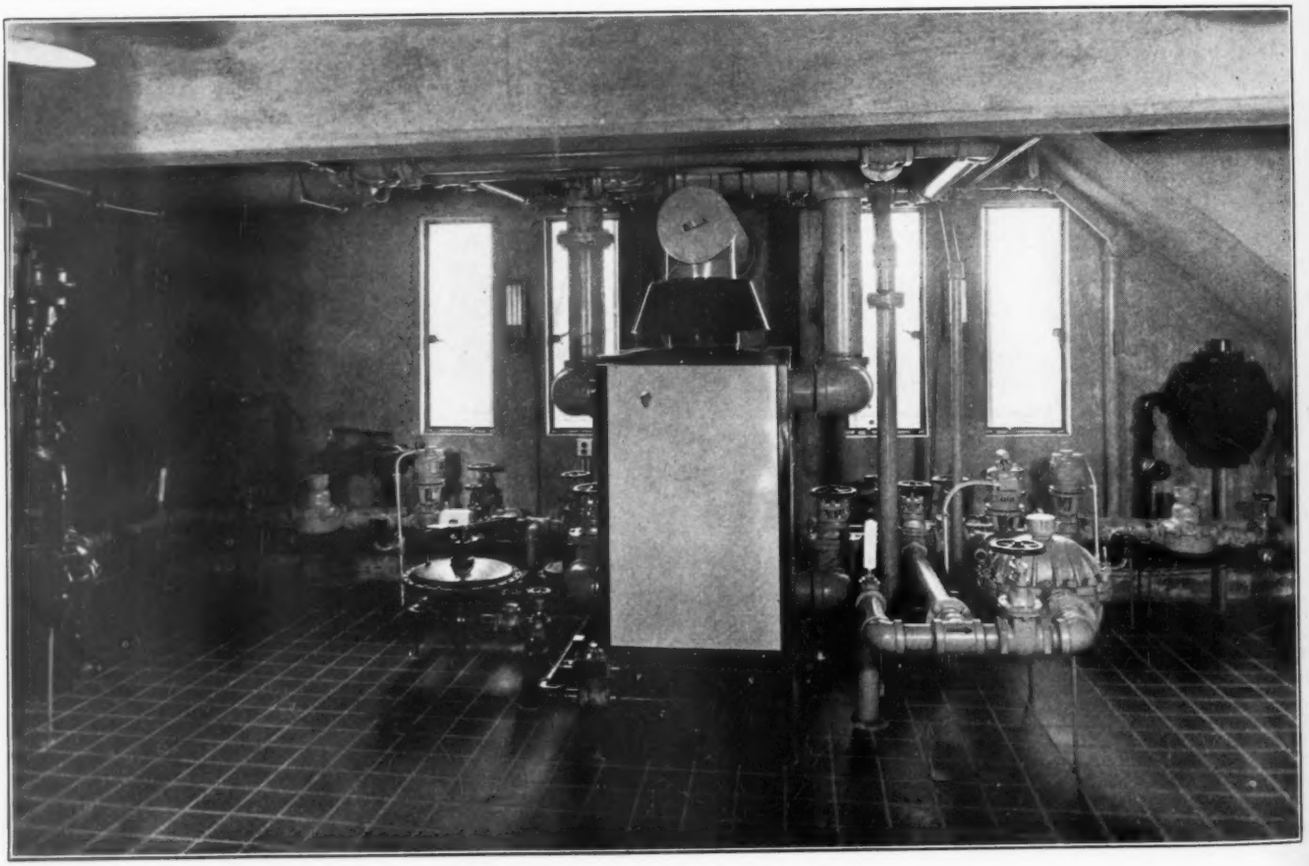
The digestors are heated by water circulated through wrought iron pipe heating coils having 1 square foot of external surface to 80 cubic feet of tank capacity. The single heating boiler is an American Radiator gas fired boiler with a capacity of 280,000 b.t.u. per hour. The grids in the boiler are of the ribbon type and burn either sludge or manufactured gas or any mixture of both without any manual change of controls. Manufactured gas is used at all times for pilots in the waste gas burner and boiler.

Other digestor equipment includes the following: a Wallace and Tiernan dry feed machine for applying lime to the incoming sludge, a sludge conditioning tank, three Pittsburgh hot water meters for measuring water circulated in the heating coils of each tank and also hot water used for heating buildings, three Pittsburgh gas meters to measure gas production from each digestor and also the amount wasted, recording thermometers on the digestors, Thrush hot water circulating pumps, Pacific Flush Tank Co. water gas burner located on roof of digestor control building and other customary accessories such as flame traps, ventilating fans, etc.

Before the plant was placed in operation considerable thought was given to the question of seeding one of the digestors, but it was decided to take a chance on starting digestion with only raw sludge. Results to date indicate that seeding would have been unnecessary. The first sludge was pumped to the digestor on May 3rd; on May 31st the waste gas burner was lit, at which time the only tank in service was producing 1200 cubic feet of gas per day. On June 9 sludge gas was turned into the boiler to be used with manufactured gas for heating the sludge and on June 18th the manufactured gas was shut off (excepting for the pilots) as the tank was producing about 4,000 cubic feet per day, which was sufficient to maintain the tank at a temperature of 85°. At no time was there any foaming or other trouble but we did have to add from 50 to 300 lb. of lime daily to keep the pH up to 6.8 or 7.0.

Sludge Bed

The sludge bed has a total area of 5,600 square feet providing 0.4 square feet per capita for 14,000 population. The bed is glass covered with all steelwork galvanized and was constructed by Lord & Burn-



The Gas Room, Ossining's Main Plant

(In which the key-note of design was safety.)

One End of the Laboratory
(Not many small plants can boast better.)

ham. The bed is divided into six units. Dried sludge is removed with the aid of a monorail, hoist and dump bucket.

Administration Building

The administration building is a one story building 40′ by 66′ in plan. Buff face brick with terra cotta trim is used for the exterior. Interior walls are plastered or faced with ceramic glazed structural tile. Floors are of red quarry tile. Aluminum metal is used for all frames and sash. This building houses a combination office and laboratory, motor room, control room, garage, chlorine room, and also a room containing the Parshall flumes, comminutor and wet well. That part of the building in which there is any sewage is separated from the rest of the building by a 12″ brick wall.

Liberty Street Treatment Plant

An Imhoff tank was selected for the Liberty Street Plant because favorable head and foundation conditions made it possible to construct the tank largely above ground reducing the high cost of excavation and foundations—a drawback that frequently operates against this type of tank because of its depth. Another reason for this choice was that it was desired to have this plant cared for by the operator of the main plant and it was felt that an Imhoff tank would require less attendance than types employing mechanical equipment. The total construction cost was $31,-840.46.

The sewage is pre-chlorinated, then passes through a hand-cleaned bar screen, grit chamber and 6″ Parshall flume to the Imhoff tank, which is divided into two units—each with two flowing-through chambers and three gas vents. The flowing-through compartments are designed to give a detention period of 2.2 hours on a flow of 500,000 g.p.d. and the sludge compartments to have a capacity of 3.25 cubic feet per capita for a population of 2,000.

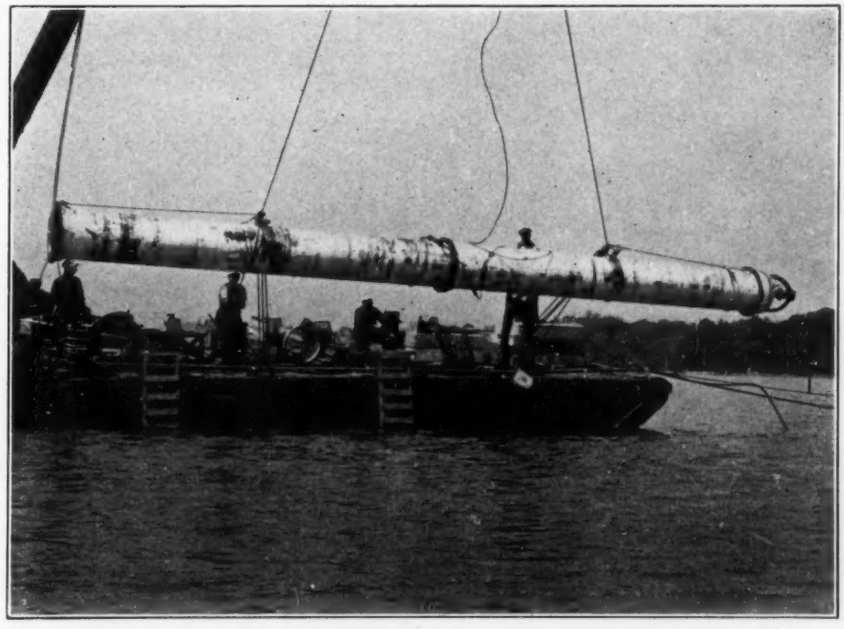
Entire Plant in Glass Enclosure

An unusual feature of the plant is that a control building is constructed on the west face of the tank. This building has three rooms on the ground floor. One of these provides storage space for two one-ton chlorine containers; a second contains chlorinating equipment and the third is a tool room and also provides access to the operating floor located above. The operating floor contains the Simplex metering instrument and also gives room for the operator to clean the screens and grit chambers. The control building and Imhoff tank are covered by a single Lord and Burnham glass cover.

The glass covered sludge bed is divided into two sections. The net area of the bed is 1,200 square feet, equal to 0.6 square feet per capita for 2,000 population.

Outfall Sewers

A 24″ outfall sewer 1,000 feet long was constructed for the Water Street plant and a 10″ outfall sewer 800 feet long for the Liberty Street plant. The Water Street line terminates in 8 feet of water at low tide and the Liberty Street outfall in 10 feet of water. Neither of these sewers extends to the main river channel because the channel is 3,200 feet from shore at the Liberty Street plant and 4,300 feet from shore at the Water Street plant. The expense of running the outfalls out such a distance would have been almost prohibitive, how-



Laying the 24″ C. I. Outfall
(In the end of the pipe is the device for centering the pipe ends in the laying.)

ever, they were designed with the idea of future extension when and if necessary.

The Water Street outfall sewer has a capacity of 9.8 m.g.d. as constructed and 6.5 m.g.d. if extended. The Liberty Street outfall 2.2 m.g.d. as constructed and 1.5 m.g.d. if extended. Class 150 enamel lined cast iron pipe with the U. S. type joint, manufactured by the U. S. Cast Iron Pipe and Foundry Company, was used for both outfalls. The river bottom at the Water Street outfall was sandy and no piles were required excepting at the extreme outer end. The Liberty Street outfall, however, is laid on piles for its entire length, one pile bent being provided for each 18 foot length of pipe. The outfall sewers cost $39,886.42. On a unit price basis the 24" line cost $20.00 per foot without piles and $28.30 per foot with piles and the 10" cost $14.00 without piles and $22.30 with piles. Both outfall sewers were tested under a water pressure of 20 lb. per square inch. The amount of leakage was negligible and in the case of the 24" line was equivalent to only 0.44 gallons per inch diameter per mile of pipe per 24 hours.

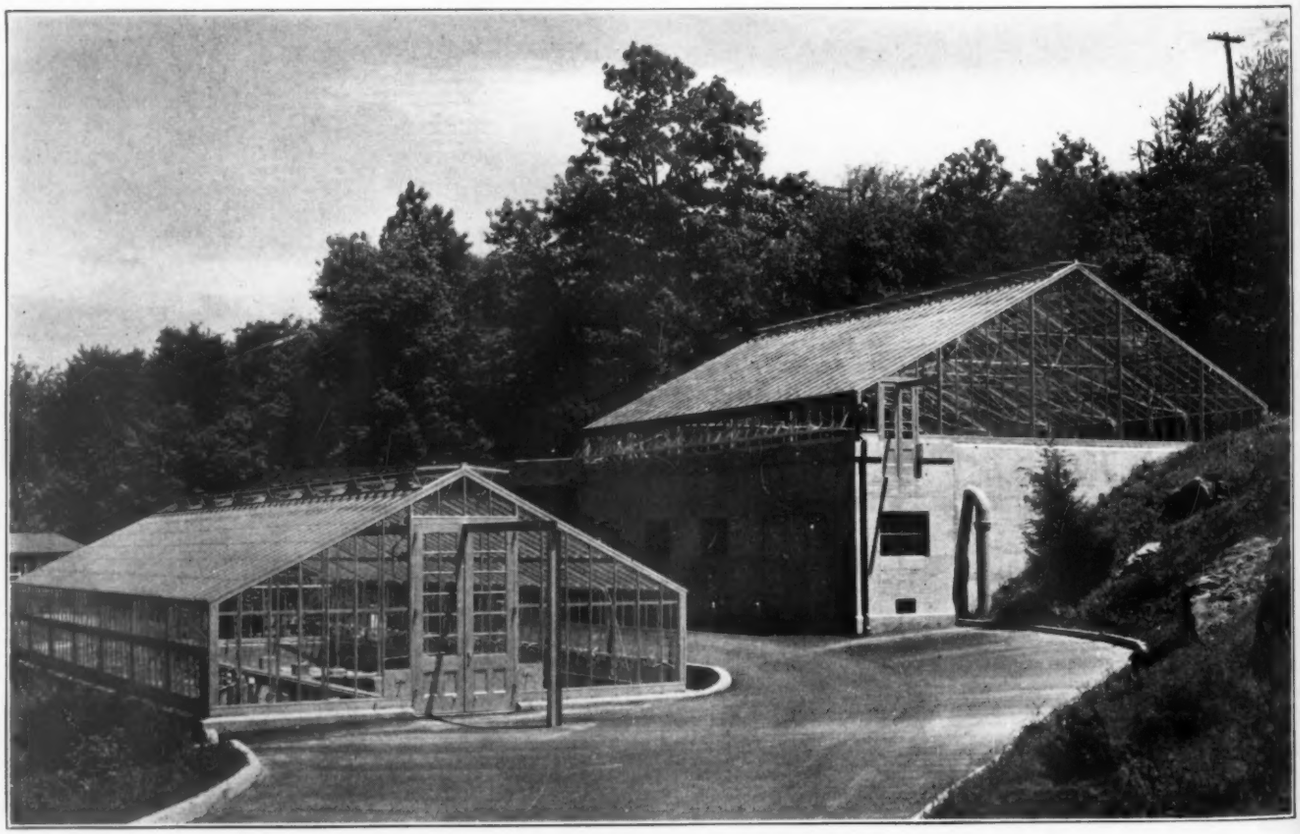
Cost of Project

The estimated total cost of the work was $300,000 and the actual cost $299,858.15, of which $253,031 represented construction costs. An analysis of the construction cost of the Water Street plant is as follows:

Item	Total Cost	Per M.G.D.[1]	Per Capita[2]
1. Grit chamber incl. removal equipment	$ 2,565.50	$ 1.282.75	0.18
2. Flumes and mete s	3,290.00	1,645.00	0.24
3. Comminutor	3,115.00	1.557.50	0.22
4. Sewage pumps	1,100.00	550.00	0.08
5. Chlorinating equip. (excl chlorinator)	1,543.00	771.50	0.11
6. Administration bldg., substructure incl. pump room, wet well and foundations	14,648.00	7,324.00	1.05
7. Administration building superstructure incl. heating and plumbing	11,385.00	5,692.50	0.81
8. Clarifiers incl. piping and equipment	14 237.80	7,118.90	1.02
9. Digestors incl. piping, covers, control bldg. and all equipment	48,032.50	24,016.25	3.43
10. Sludge beds	13,680.00	6,840.00	0.98
11. Exterior piping and valves	6,193.70	3,096.85	0.44
12. Electric work entire plant	3,738.00	1,869.00	0.27
13. Misc.—tools, supplies, laboratory equipment, furniture, etc.	4,200.00	2,100.00	0.30
14. Landscaping, walks, drives road, drainage and demolishing existing buildings	12,800.00	6,400.00	0.91
TOTAL	$140,528.50	$70,264.25	10.04

[1] Based on 2 m.g.d. flow. [2] Based on 14,000 population.

The project was planned and constructed under the supervision of the author. E. H. Aldrich had charge of design, J. W. Schmidt handled the architectural treatment of the administration building and digestors. Paul G. Van Brunt was resident engineer and Paul L. Grambs, Resident Engineer-Inspector for the PWA. Valuable assistance in the designing and placing in operation of the plant was rendered by Guy Griffin, sanitary Engineer in charge of sewage treatment at Greenwich, Conn.



The Liberty Street Plant of Ossining, N. Y.

(All enclosed under glass. On right the Imhoff tanks, inlet works and control house; on left the sludge beds. The chief end was odor prevention by closing up the covers at night-fall or on muggy days. In addition pre-chlorination is employed in summer.)

CROSS CONNECTIONS TO STEAM BOILERS

Some Hazards Created and Methods of Correction

By R. F. GOUDEY
Sanitary Engineer
BUREAU OF WATER WORKS AND SUPPLY
LOS ANGELES

DURING the past several years an increasing battle on the elimination of cross-connections has been waged by health and water officials all over the country. Boilers with connections to both drinking water and polluted supplies were recognized ten years ago as dangerous and there also has been a general program all over the country to protect connections to them. The report of "Committee No. 8, American Water Works Association" in 1933[1] recommended definitely that these types of cross-connections be eliminated. The City of Los Angeles passed its cross-connection ordinance in 1931 and it was written to be even broader than most ordinances in other cities.

A new conception of cross-connection dangers arose in June, 1936, when the United States Public Health Service inaugurated a survey of cross-connections in New York and Detroit under the P.W.A. and listed boilers, hot water heaters, sterilizers, and autoclave as dangerous cross-connections even though no secondary water supply is involved, but where conditions might originate which would contaminate or pollute the domestic water supply. The Bureau of Water Works and Supply of the City of Los Angeles, without knowledge of this policy of the United States Public Health Service above mentioned, concluded in August, 1937, that such types of connections should be protected.

On August 24, 1937, a form letter was sent to the leading boiler and tank companies in the City of Los Angeles as follows:

"Your attention is called to the attached copy of Ordinance No. 77,000, sections 38.02 and 38.03 which prohibits direct connection between the City drinking water and any tank, cistern, reservoir, or any receptacle for the storage or use of water, unless such water is received above the topmost rim of any such tank, etc.

"It has been brought rather forcibly to our attention that boiler feed water connections made direct to the City system endanger the purity of the drinking water.

"You are probably aware that hot water and steam frequently back from the boilers into the cold water system. To eliminate the danger caused by direct connections to the City system it has been found necessary to order the severance of the existing connections between all boilers and the City water system. No special drive will be made for this purpose, but their removal will be accomplished through our regular cross-connection survey and each boiler will be cited, together with any other cross-connections which may be found.

"The Ordinance will be rigidly enforced against all boilers as well as other types of connections to the City water. This problem is brought to your attention so that you may have an opportunity to cooperate on future installations, thereby avoiding possible misunderstanding at a latter date.

"Several boiler representatives have expressed a desire to discuss the most economical as well as the most satisfactory method of eliminating direct City water connections to boilers. It is the desire of this Department to cooperate to the fullest extent with both manufacturers and property owners. Therefore, a meeting has been arranged in Room 1028, 207 S. Broadway, at 2:00 P.M., August 31, 1937, to discuss ways and means. A representative from your organization is cordially invited to attend this meeting."

The Author

The conference called for in the above mentioned letter was attended by representatives of the majority of boiler manufacturers in Los Angeles, by representatives of leading insurance companies, and by Mr. C. E. McGinnis, General Manager of the Board of Mechanical Engineers, Los Angeles. After a full discussion of the subject there was a general agreement of the need of protection and of various methods of correction. This meeting was followed by an opportunity made possible by Mr. McGinnis for a representative of the Bureau of Water Works and Supply attending the meeting of the Certified Boiler Inspectors' Conference held at the State Building, Los Angeles, on September 10, 1937, where final agreement was consummated for local and State inspectors, together with some of the insurance company inspectors, to assist in a program of education to sever connections before new annual permits to operate were granted, and to require in all new installations a broken city water connection somewhere between the water meter and the boiler feed water tank.

The Los Angeles Program

The Bureau of Water Works and Supply agreed not to wage a general or militant campaign, but in the course of its regular survey of cross-connections in the city, by one of its inspectors, to eliminate all boiler connections as they were met. During the following two years, direct connections were eliminated in 217 low pressure boilers and 243 high pressure boilers in the business district alone and in no instance was any difficulty encountered in obtaining compliance with ordinance requirements.

An additional program of protecting against direct connections to boilers has been conducted by the Bureau of Water Works and Supply in the oil field areas in the southern part of the city. The general practice there is for each oil drilling outfit to install a battery of four boilers with 150-250 lbs. pressure tied in with their general field water system, all of which is supplied only by city water but for many purposes inimical to the safety of the water supply. These services have been protected in

[1] American Water Works Association Journal, Vol. 25, No. 3, page 419.

two ways: first, installation of a tank at the property line fed by an overhead discharge from which all water pumped to the oil lease system, including the boiler feed lines, is supplied; and, second, by the Lohman Brothers E-C Valve, which has been accepted by the Bureau of Water Works and Supply as a mechanical device equivalent to a broken connection.

The City Health Department during the past year has been conducting a program on the elimination of direct boiler feed connections at all hospitals and school buildings in the City of Los Angeles.

Excellent cooperation has been received from the Board of Mechanical Engineers of the City of Los Angeles and a number of inspectors from various insurance companies. There is still need, though, of a more concerted action on the part of insurance inspectors covering corrections for boiler installation covered by insurance which are not inspected by Mr. McGinnis.

Reasons Why Boiler Connections Are Dangerous

Ordinary cross-connections are condemned because of excess pressures, which can be built up on a secondary or used supply. Cross-connections to boilers, like many types of plumbing fixtures, are dangerous because of the back-siphonage possibility of drawing contaminated or poisoned water into the domestic water system. The properties of steam make boiler cross-connections even more dangerous than ordinary plumbing cross-connections. A given volume of water converted into steam at normal atmosphere increases its volume about twenty-six times. Accordingly, leaky check valves through which steam under pressure from boilers may escape into the water system drives back the water, causing steam to flow out of the water fixtures. This causes damage to water meters and direct burns to persons using plumbing fixtures. The Bureau of Water Works and Supply has had a record of over 5,000 water meters destroyed annually in the City of Los Angeles caused by steam backing up from boilers or hot water heaters. Charge for this damage and improved thermostatic control has reduced this to 2,300 per year. As yet no practical meter has been devised to resist damage from steam and hot water.

The literature is replete with explosions from hot water heaters due to overheating and the illustrations contained in an article in the American Water Works Association Journal, Vol. 11, page 88, shows sufficient instances of extreme damage resulting from such explosions. In the case of Henri Bouri vs Spring Valley Water Company,[2] in 1908, the water company installed a check valve, without notice to the consumer, to prevent relief of excess boiler pressure into the water system which had been occurring regularly. The boiler subsequently exploded, causing considerable damage. The Appellate Court ruled that the water department in this leading case acted within its rights in protecting the water system against steam which would deteriorate the quality of water and that the property owner had no right to use the water system for steam pressure relief and had no cause for damage. It is significant that the court ruled in this case that boiler feed water or steam when discharged back into the domestic system impairs the quality of water and renders it unsuited for domestic use.

There are records also of compressed air flowing back into the water system reversing the direction of the meter and causing air to be served to consumers in place of water. This is in spite of check valves, ordinary valves, and supposedly intelligent operation. Steam can do what air can and this additional evidence only illustrates the greater care which must be taken with boiler feed compounds.

Steam cross-connections are again dangerous because steam on condensing, either in steam lines or in the boiler itself, creates a vacuum which in leaking by check valves, valves, or deliberately fully connected to the water system by the direct opening of the valve causes immediate inrush of anything in all connected lines towards the boiler. This may result in an excess use on other parts of the water system and cause serious back-siphonage. The magnitude of this change is realized when one considers that the force of this vacuum is equal in magnitude to the explosion of steam at 14.7 lb. per square inch from an equivalent volume of water which formed the vacuum in question. It is a reversed explosion. For many years doctors at hospitals have been wondering why many patients died from infected incisions following operations. The answer has generally been that supposedly sterile water used to wash wounds and instruments, with bandages supposedly made antiseptic in sterilizers, autoclaves and instrument cabinets where sterilization by steam has been practiced, became infected in many instances from back-siphonage, caused by partial vacuums when the sterilizer steam condensed, sucking in polluted water.

Further Hazards of Boiler Feed Cross-Connections

Direct water services to high and low pressure boilers are hazardous for the following additional reasons:

1. Most all boilers have a device into which the boiler compounds, powdered or liquid, may be fed to the boiler feed water. These patented compounds are usually secret and many of them are labeled poisonous. Caustic soda is common to most of them. This forms a bulky sludge which not only impairs the carrying capacity of water lines when backed up into them, but results during over-treatment in a highly alkaline water which is not permissible under Treasury Department Standards of the United States Public Health Service to be used for domestic purposes. In other instances muriatic acid is used incorrectly but directly as a boiler compound. It releases enormous quantities of carbon dioxide gas, which is corrosive and either in its carbon dioxide gas condition or as muriatic acid dissolves iron, which on getting back into the water supply, causes vomiting, staining of laundry and discoloration of enameled bathroom fxtures. Other compounds contain tannins, phosphates, aluminates, silicates, which likewise have detrimental effects.

Many boiler feed compounds, including most of those fed to hot water heating systems, contain phenolphthalein, which is the active ingredient in "Ex-Lax" and "Feenamint." In instances where this material has gained access to water supply through boilers and hot water systems, extreme weakness from diarrhea has been caused.

The addition of silicates or other boiler feed compounds direct to hot water systems is a vicious practice because a considerable number of people starting the day with a glass of hot water become inconvenienced. A number of serious complaints have reached our Department which can be laid to this source.

That this danger is not imaginary is illustrated by the following incidents:

(1) At McClure's Winery a boiler feed pump was connected to the discharge side of the Los Angeles water

[2] California Appellate Reports No. 8, Pomeroy, 1908 page 588.

supply with a by-pass arrangement for feeding boiler compound. In treating the boiler feed water, someone apparently turned the wrong valve and pumped the compound to the drinking water supply instead of the boiler. All employees at the Winery were affected, two being confined to bed for a day.

(2) At Pomona College, Claremont, each year diarrhea and severe enteritis was observed in the Fall, affecting practically all college students and faculty, following the annual use of a boiler compound in the hot water system which, since its discontinuance, has terminated the difficulty.

The use of boiler feed compounds should, therefore, be restricted to that part of the hot water or boiler feed system which has been completely separated from the domestic water system. Even though some of the compounds used are non-poisonous, all alter the water and change its suitability for domestic purposes. The addition of boiler compounds marked "poisonous" to boilers, not separated from the domestic water system, is nothing short of criminal.

2. Both high pressure and low pressure boilers are connected directly to the sewer or sewer sumps, such that if back-siphonage occurs the domestic water may cause typhoid. In a survey of 217 low pressure boilers, 184 were directly connected to sewers or sewer sumps. Of the 243 boilers inspected, all were connected to sewer sumps. This direct connection of boilers to sewers under back-siphonage conditions may cause pollution of the water supply with raw sewage and is an extremely dangerous condition. However, only one typhoid epidemic of this type has come to the attention of the writer. It was an epidemic involving 23 cases at a lumber mill city in Arizona in 1929 which was caused by a vacuum being created in a surface condenser, which sucked up sewage into it and when a water line valve was opened when pressure was zero in the water line, sewage drained by gravity from the condenser into the water system. The same principle is involved in many boiler installations in the City of Los Angeles.

Boilers subject to intermittent use with frequent fluctuations between high pressures and partial vacuums are particularly dangerous because sudden opening of valves may cause unexpected reversals of flow or even back-siphonage.

3. Salts accumulate in boilers and when heavy concentrations are back-siphoned into the domestic water supply the latter is rendered unfit for domestic use. Hot water heaters of the self-cleansing type slough off scale and solids to the extent that consumers complain of "sand" in the water. A specific instance was a complaint from Leonard's Restaurant, 800 E. 5th St., Los Angeles, where frequent low pressures and improperly designed plumbing caused sediment from the hot water tank to be siphoned into the drinking water system. Similar complaints might originate from wrong boiler practice.

4. Boilers directly connected to water systems in many instances result in steam backing up to meters, destroying them, and in gushing out into toilet fixtures causing considerable annoyance and damage. This occurs even where check valves are installed. Reports indicate that one out of fifty in Los Angeles are defective and in a number of cases they have been by-passed after the date of their original installation.

At Hermosa Beach a lady in using the toilet was badly scalded by steam from a direct connection to a hot water system and which caused serious third degree burns. The court awarded her $16,700 damages.[3]

Other cases of this type of abuse is where city water pressure is used directly to fight oil and gas pressure in oil wells.

On June 3, 1939, at Fullerton, the Bartholomae Oil Corporation attempted to kill the gas pressure on an oil well with a direct city water connection. Oil entered the city's 75,000-gallon storage tank in the North Gate Heights District and was served to consumers in the vicinity. It took over 300,000 gallons of water to remove the oil and gas from the domestic system.

5. There is always danger by some engineers, largely of the Filipino house boy type, in making by-passes, some of which constitute serious types of cross-connections.

The general tendency of engineers to inter-connect piping without regard to safety is a general complaint of health officials throughout the country and has resulted in their recommending that all boiler and engineering rooms be under the supervision of a sanitary engineer. In New York no chemicals for anti-corrosion or anti-scale can be added to boilers or hot water systems except by persons under permit of the Board of Health. The need of greater care in boiler operation is apparent.

6. Steam lines connected to water lines may cause an injector action, exhausting the water lines and causing back-siphonage in them. If these lines are connected to sewer sumps, hot wells or house pumps, directions of normal flows may be reversed. Flooded steam return lines may cause entrance of polluted water back into domestic lines under certain conditions if no separation has been provided.

Elimination of Cross-Connections

Boiler feed lines have been disconnected in one of the following methods.

1. A broken connection by installing a high inlet float controlled to a tank from which water is pumped by electric or hand power to the boiler.

2. An overhead tank with above-the-rim inlet for boiler pressures permitting gravity flow from such elevated tanks. This is restricted to low pressure boilers.

3. A small gravity injector tank which, after being filled by an overhead inlet, can be so valved with the boiler that steam can be admitted to the top, thereby causing the water to flow into the boiler from the bottom. This method has been used only in three cases during the past two years because many engineers felt that it did not comply strictly with ordinance requirements.

4. E-C Valves, which are mechanical devices that completely separate the domestic water system and boiler feed lines in that under higher pressure from the boiler side there is a vent to the atmosphere and under negative pressures on the city water side there is a shut-off with adequate ports to admit of air intake to satisfy leakage.

Forty-one boiler installations are not protected in the City by this method with a prospective increase in the public school system to over four hundred. This latter method gives greater certainty of boiler feeding and should warrant endorsement from boiler inspectors of insurance companies.

Acknowledgement — This paper was presented by the author before the Association of Boiler and Elevator Inspectors of California, in Los Angeles, California, January 10, 1940.

[3] Civil No. 11585, Second Appellate Dist. Div. 1, Dec. 9, 1938, Juanita Harmon vs M. H. Sherman Co. and others.

N.E.W.W.A.'s 1940 CONVENTION PLANNED FOR TWO-FOLD PURPOSE

To be Held in New York City, September 24-27
An Afternoon and Evening at World's Fair an Entertainment Feature

FOUR years ago in September, 1936, the New England Water Works Association in a departure from tradition decided to hold its Annual Convention in New York City. This location, a step over the line of New England territory, was chosen as the outcome of a suggestion that a greater number of water works operators would be served thereby. The reason for such was the fact that few men from the Central, Atlantic, and South Atlantic States had been able to make the trip to Los Angeles to attend the Convention of the American Association and in consequence might be served by staging the New England Convention as far west as seemed permissible.

The idea panned out just as anticipated and New England's meeting of 1936 in New York City proved the best attended and most successful of any in its long history. The registration list revealed that a large number of men had come from territory east of Cleveland and from the South —some had even come from points as far west as Chicago.

Now the same plan is to be repeated in 1940, for the reason that the Kansas City Convention of A.W.W.A. was generally without the reach of many men who may, on the other hand, be able to travel to New York City to attend the New England Convention in September. A further consideration in selecting New York City was the fact that many may wish to attend the World's Fair and will thereby, have the dual opportunity of taking in a Water Works Convention and, at little added expense, be able to visit the World's Fair before returning home.

This year the New York, New Jersey and other eastern Sections of A.W.W.A. are especially invited to participate in the New England Convention and plans are being made to consider the convention as taking the place of the customary fall meetings of the N. Y. and N. J. Sections of A.W.W.A., which will hold business session luncheons during the convention.

An Evening at the World's Fair

Looking forward to a meeting perhaps larger than any ever held by N.E.W.W.A. the Entertainment Committee, headed by Clinton Inglee, is planning an exceptional program of entertainment. The feature planned is to be the afternoon and evening in the World's Fair. In addition there will be the customary features of entertainment which closes with the Annual Dinner and Dance.

As to Manufacturers' Exhibits, J. Herman Smith (in charge) advises of an unexpectedly high and early interest on the part of exhibitors, presaging a very fine show of equipment and materials which is expected to rival that of the Kansas City Convention.

The Technical Program

In the general sessions of the meeting, major attention is being given to the topic—"Water Supply and Water Works Practices in War," in which particular consideration is being given the matter of vulnerability to sabotage and measures to pursue in preventing and guarding against such. This subject is to be introduced by one fortified with extensive experience in the First World War, Colonel Francis F. Longley of Ampere, N. J., who will be followed by others of experience in this country and abroad.

Superintendent's Papers

"Problems of Municipal Water Works Management"—L. R. Howson.

"Three Major Events in the Life of a Small Water Company"—Henry T. Gidley.

"Cooperation Between Fire and Water Depts."—R. C. Dennett.

"A New Tar Coating for C. I. Pipes"—W. A. Brown.

"Promoting Tax-payer Interest"—C. Schwarzler.

Committee Reports, covering Meter, Hydrant, and C. I. Specifications; Emergency Procedures; Tolerances in Water Quality, etc.

Chemists' and Engineers' Papers

"Results of Field Studies of Conditions on the Inside of Water Distribution Systems"—W. J. Scott.

"Sanitation and Treatment of N. Y. City's Water Supplies"—F. E. Hale.

"Sanitation and Treatment of the Wanaque, N. J. Supply"—L. T. Purcell.

"Accelerated Clarification"—F. J. Lammers.

"Filter Operation and Maintenance"—John R. Baylis.

General Sessions

"Changing Perspectives in Water Resources, Development and Control"—Thorndyke Saville.

"The Supervision of Dams and Reservoirs in Connecticut"—C. M. Blair.

"Effects of the 1939 Drought on Water Supply Developments in New Jersey"—Chas. A. Capen.

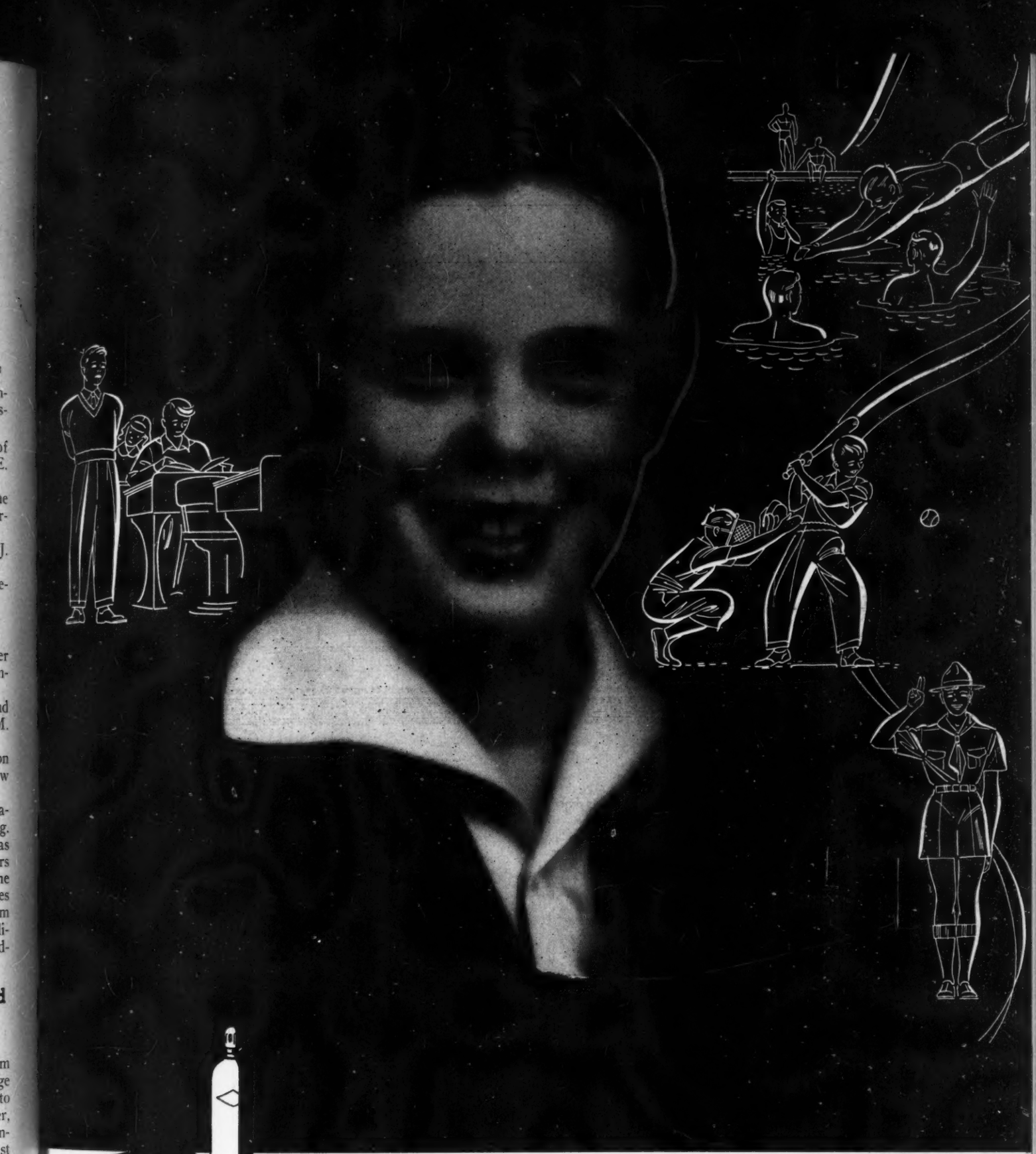
"Construction of New York's Delaware Aqueduct"—R. W. Armstrong.

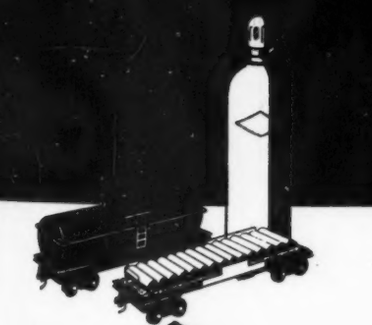
The program at this writing was not completed and additional papers are being arranged for. However, the discussion of protective measures against sabotage and the symposium on war-time operation of water utilities should in itself justify attendance.

Philadelphia Going Ahead With Sewage Treatment Program

For a time the proposed program of sewerage betterments and sewage treatment for Philadelphia seemed to have run up a "blind alley." However, legal difficulties have now been untangled and a new program is at last under way for the east's most important sewerage project in sight.

Gascoigne and Associates, of Cleveland and New York, have been retained as engineers to make the required investigations and report as to the recommended degree of treatment and type and capacity of treatment plant, with estimates as to construction costs.





CHLORINE

To faithfully fulfill your obligation—to protect the health of your boys and girls, a vital need is liquid chlorine of the highest quality for water purification. The unfailing purity and dependable uniformity of DIAMOND LIQUID CHLORINE leads experienced engineers everywhere to standardize on this reliable product. So, in the interests of better health, better service, better satisfaction, we suggest that you, too, specify DIAMOND for *all* of your Liquid Chlorine requirements the year 'round.

DIAMOND ALKALI COMPANY

Pittsburgh, Pa. and Everywhere

ERNEST L. H. MEYER

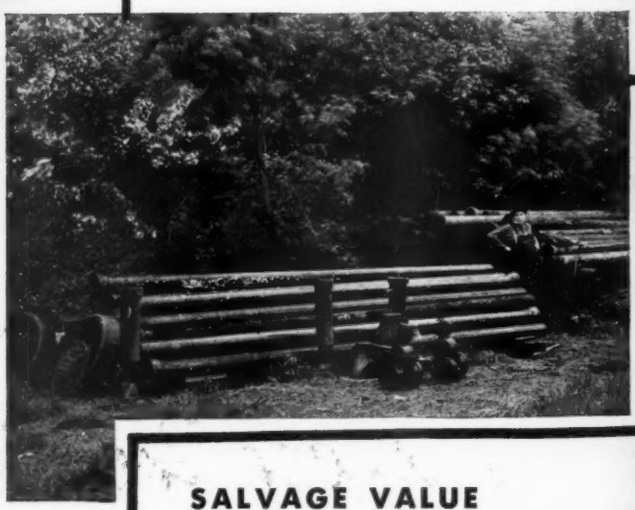
LOW MAINTENANCE

is an economy factor in cast iron pipe that is usual, rather than exceptional, in water works experience. An impartial survey among nearly 200 water works superintendents shows that the maintenance cost of cast iron pipe is far below that of any other pipe material which has been in use long enough for the recording of conclusive data.

LONG LIFE

Unretouched photo of 110 year-old cast iron water main, laid in the year America's first railroad was completed, now rendering satisfactory service in the water distribution system of Philadelphia. No wonder they call cast iron pipe Public Tax Saver No. 1!

Look for the "Q-Check" registered trade mark. Cast iron pipe is made in diameters from 1¼ to 84 inches.



SALVAGE VALUE

Photograph shows part of 3,000 feet of 6-inch cast iron pipe salvaged after 46 years service for relocation elsewhere in the City of Lake Geneva, Wisconsin. The original line was replaced with 10-inch cast iron pipe—naturally!

SALVAGE VALUE THRIFT-FACTOR

SPRINGFIELD, ILLINOIS

IN 1938, salvaged and relocated 5 miles of 24-inch cast iron pipe which had been in service for 21 years, utilizing every length and saving $100,000 over the cost of new pipe.

READING, PENNSYLVANIA

IN 1939, completed the relocation of 7 miles of 36″, 30″ and 24″ cast iron pipe—salvaging 98½% of the 30-to-40-year-old original pipe. The cost of 7 miles of new pipe would have been $350,000.

GLENDALE, CALIFORNIA

IN 1938, salvaged and relocated for the second time 48-inch cast iron pipe bought from the City of Philadelphia where it was taken up, after 24 years service, because of subway construction. Glendale installed the reconditioned pipe in 1925 and 13 years later it was relocated to begin a third life of useful service.

BLACK OUT ALGAE

with ACTIVATED CARBON

Growth of algae in sedimentation basins has been controlled with AQUA NUCHAR Activated Carbon. One of the important essentials for propagation and growth of algae is sunlight. When AQUA NUCHAR is applied to the mixing basin, its superior ability to remain suspended in water for long periods of time acts to prevent penetration of sunlight into the water. In this way AQUA NUCHAR eliminates one of the causes of algae growth.

The superior suspendability of AQUA NUCHAR has been utilized to advantage in a number of water plants to "black out" settling basins. AQUA NUCHAR also goes further and eliminates tastes and odors from your water supply at the same time that it is working as a "black out" against algae growth.

Read about an actual experiment reported in the July issue of "Taste and Odor Control Journal." If you have not received the July 1940 issue of "Taste and Odor Control Journal", write for a copy today.

INDUSTRIAL CHEMICAL SALES

DIVISION WEST VIRGINIA PULP AND PAPER COMPANY

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230 Park Avenue

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748 Public Ledger Bldg.

CLEVELAND
417 Schofield Bldg.

Manufacturers of NUCHAR *Activated Carbon*

PENNA. SEWAGE WORKS ASS'N.

Honors 13 Past-Presidents and Retiring Secretary; Features "Operators' Clinic"

ON the heels of the 13th Annual Conference of the Penna. Water Operators' Association, the proceedings of which were reported in our July issue, followed the 14th Annual Conference of the Penna. Sewage Works Association, held on the campus of Penna. State College, June 26-28. The registration was 177, and the attendance appeared to be at least 200.

As in previous years the open afternoon between the closing of the Water Conference and the opening of the Sewerage Meeting was given over to a joint golf tournament, tennis and base-ball.

On the evening of the 26th, the customary opening lecture was this year given by E. W. Gilliland, Chief Chemist of the Mine Safety Appliances Company of Pittsburgh. Mr. Gilliland, with what seemed to be about a van-load of various pieces of safety equipment, explained the application of each in connection with sewer maintenance and plant operation. In general, dangers to sewerage operators lay in three directions: (1) oxygen deficiency; (2) poisoning by toxic gases; (3) fire and explosion. In the first instance when air, normally 20% oxygen, dropped to 15% oxygen, workers suffered discomfort, and at 10% danger existed. In toxic gas poisoning the insidious hydrogen sulphide gas was the most dangerous in sewerage practice, since in dangerous concentrations the victim cannot smell it, becomes paralyzed and helpless. Finding that some sludge gas contains as much as 0.1% hydrogen sulphide, Mr. Gilliland emphasized that it was important to remember that as little as 1/200th of this amount (0.005%) is toxic and paralyzing. At this point he showed the sensitive test unit for sulphide determination based on the production of sulphide stain of various intensities on paper strips impregnated with cyanide of silver. For estimating carbon monoxide (CO), in testing atmospheres for safety, an ampoule of palladium chloride is employed. As to explosions, sludge gas and air combinations between 5.3 and 19% gas by volume are explosive, higher concentrations being flame propogating but not explosive. In discussing gas masks, Mr. Gilliland said that the safest mask of any is the hose-mask. It can be used with as much as 150 ft. of hose if a hand blower is operated—otherwise 25% of hose is the limit.

Presidents

(*Retiring*) (*Incoming*)

Geo. M. Olewiler, Sup't. of Sewerage, Lower Merion Twshp., Ardmore, Pa.

Geo. P. Searight, Boro Manager, Carlysle, Pa.

Robert Spurr Weston Guest Speaker

Robert Spurr Weston, Boston Consulting Engineer, was the special guest speaker at the Annual Dinner. Mr. Weston's subject was industrial pollution—the theme of which was "Stream Use vs. Stream Abuse."

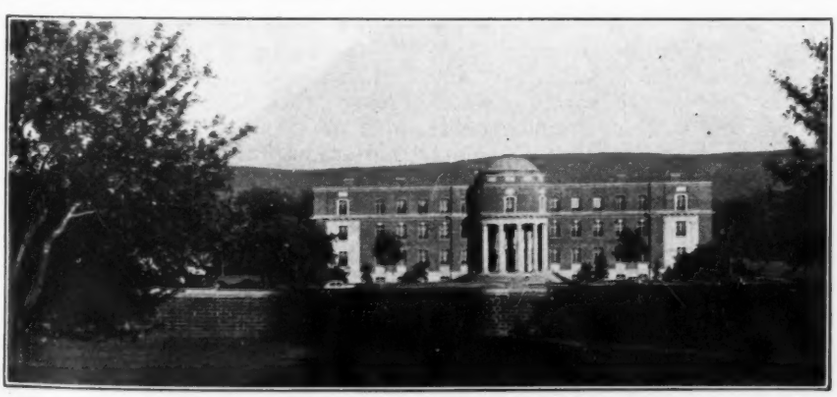
In this Mr. Weston pointed out that in treating industrial wastes it was impossible to generalize on the type and degree of treatment requisite. Like a physician, the engineer should study each case as an individual problem, weighing the capacity of the stream and developing treatment to stay within the practical and economical limits—i.e., thus putting the stream to full use, while circumventing abuse.

13 Past-Presidents Honored

At the head table all of the 13 past-presidents of the Association answered to the roll call of H. E. Moses, Master of Ceremonies and 2nd President, who presented each an especially struck past-president's emblem. Taking the form of a pendant-key, very similar in design to those worn by past-presidents of the Water Operators Association, the shape is that of the Penna. Keystone. It has a dark blue enamel field on which appears raised letters in gold.

Those so honored, starting with Professor Walker, founder and President Emeritus, and ending with retiring-president, Olewiler, were:

(1927) E. D. Walker, State College
(1928) H. E. Moses, Harrisburg
(1929) L. E. Burnside, Sharon
(1930) H. M. Beaumont, Philadelphia
(1931) L. W. Monroe, Ellwood City
(1932) R. O'Donnell, State College
(1933) R. L. Phillips, Meadville
(1934) H. J. Krum, Allentown
(1935) E. B. Wagner, Downingtown
(1936) R. R. Cleland, State College
(1937) F. S. Friel, Philadelphia
(1938) C. F. Grace, Polk
(1939) G. M. Olewiler, Ardmore



View From the Dormitory Court at Penn. State.

Special Recognition to "Deac" Matter

("Bernie" Bush Becomes Secretary)

It was announced that after a number of years of appreciated service to the Association as its Secretary-Treasurer, L. D. Matter having been given additional duties and responsibilities resulting from a State Dep't. of Health promotion, had asked to have a successor appointed to the Secretary's position. The Executive Board, said Mr. Moses, had logically selected the man who has for the past several years served as Assistant Secretary, and has done some real "wheel-horse" work in making meetings click. So the new Secretary-Treasurer is Bernard L. Bush, District Engineer of the State Dep't. of Health, at Wilkes Barre, Pa. (This fellow "Bernie" Bush is one of those self-starting human dynamos of perpetual motion that loses no time in getting places—a selection which can be heartily commended.—Ed.)

In recognition, and in appreciation of his splendid services, "Deac" Matter was presented by the Executive Board with a past-presidents' emblem; received a special gift from the Entertainment Committee; and, from members, a rising vote of esteem and regrets over his resignation.

Officers

T. S. Bogardus (2nd Vice. Pres.)
Asst. City Engr., Meadeville
E. B. Swineheart (1st Vice Pres.)
Sup't. Treatment Wks., Pottstown
J. R. Hoffert (P.S.W.A. Editor)
Penna. Dept. of Health, Harrisburg

Three More Wearers of the High-Hat

The honorary society of the Association has the euphoneous if not salubrious name—"The Right Honorable Society of Sludge Shovellers." The emblem is an old top-hat, of brindle hue and flaring crown, which each new member must don at the Annual Dinner. Into this august society were taken honored guest, Robert Spurr Weston, the new "Honorary Chaplin" of P.S.W.A., Frank Woodberry Jones, and one of the oldest members and most consistent conference attenders, Boyd Trescott, Boro Engineer of Berwick, Pa.

Secretaries

(Retiring) *(Taking-Over)*
L. Deacon Matter, Harrisburg, Pa.
Bernard S. Bush, Wilkes Barre, Pa.
(Both Dist'r. Eng'rs., Pa. Dept. of Health)

Sewer Cleaning Demonstration

The Water Operators' Association had its main cleaning demonstration by the "National" method. Not to be outdone, the Sewage Operators' Association scheduled a sewer cleaning demonstration by the "Flexible" method. The demonstrators tackled a tough assignment, but they asked for it. The job proved to be a root-pulling operation of some difficulty, and it was interesting to watch the dexterity with which the little rod twisting motor unit (looks like a toy automobile) was manipulated by the operator.

Technical Sessions Opened by "Parson" Jones

Two years ago, Frank Woodberry Jones, Chief Chemist of George B. Gascoigne Associates of Cleveland and New York, presented a splendid paper—"On the Starting of a Sewage Treatment Plant." It was something of a sermon of many "dos and don'ts" and there were several morals which came from experience lessons recited. Members liked his paper, and this year the man who has nursed many a sick plant back to health, and started green operators on their way with brand new plants, was called back to do a similar job.

So "Doc" Jones, peering slant-wise over his "see-all" specs, came to deliver "Sermon No. 2." This time his text was "Plant Maintenance" and, in particular, he preached on the "F.B.I." of sewage works maintenance—these catching initials standing for "Functional, Beautiful, and Inspirational." The inspirational part was Jones' talk, because at the close he had done such a splendid job on his second "sermon" in two years that he was dubbed "Honorary Chaplin" of the Association.

Pointing out that the present day trend was that of making sewage plants and surroundings so attractive to the eye as to avoid public complaint by astounding the visitor, Mr. Jones stressed the other reason for beautification—namely, encouragement of plant operators in orderliness and general good housekeeping and maintenance. All of this taken together signalized good operation and economy of maintenance when weighing long term results. In this direction, he also preached on the matter of avoiding the lowest cost equipment and materials, if long term maintenance and repair costs were to be favorable. In maintenance, visible depreciation and "squeaking wheels" receive attention, whereas natural wear was likely to be overlooked until the unit gave audible or visible signs of failure. This was something to recognize and avoid by scheduling maintenance practices.

Sewer Cleaning Demonstration

(Angling for a root with auger and "Flexible" rods.)

Concerning one of the chief ingredients of the "F.B.I." formula for successful operation, through high grade maintenance and economical functioning, "Parson" Jones singled out "Inspiration." Inspiration leading to industry was bred only in harmony between bosses and operating personnel, and those in City Hall as well as State officials. In this direction he cited the value of praising the operator who tries, and an unexcelled source of inspiration — the short-schools, conferences and meetings of sewage operators.

Eugene B. Swineheart, Sup't. of Sewage Treatment, Pottstown, Pa. (Vice Pres. of the Ass'n.), pointed to the difficulty of separating maintenance and operation when considering either. Cleanliness was the index of good operation and an important beginning in successful maintenance. He also emphasized that the last called for a carefully followed schedule of inspections and routine service work.

Painting Practice

In the general discussion on "Maintenance" painting practices were emphasized. City Engineer *R. L. Phillips,* called attenton to the

Past Presidents

(1927) (1928) (1929) (1930) (1931) (1932) (1933) (1934) (1935) (1936)

'27—Prof. E. D. Walker, State College
'28—H. E. Moses, Harrisburg
'29—L. E. Burnside, Sharon
'30—H. M. Beaumont, Philadelphia
'31—L. W. Monroe, Ellwood City

(1937) (1938) (1939)

'37—F. S. Friel, Philadelphia
'38—C. F. Grace, Polk
'39—G. M. Olewiler, Ardmore

'32—R. O'Donnell, State College
'33—R. L. Phillips, Meadeville
'34—H. J. Krum, Allentown
'35—E. B. Wagner, Downingtown
'36—R. R. Cleland, State College

paint color scheme employed for valves and pipe lines at his (Meadville) plant. Such is, with slight modification, the recommended color scheme of the American Society of Mechanical Engineers. *F. G. Diefendorf,* Plant Sup't. at Erie stated that "Inertol", a coal-tar paint, had proved satisfactory on concrete and steel work over a 9 year period. As to lubrication at Erie, two men check the same points on an every Monday schedule. *H. N. Herr,* Sup't. of Utilities, Hersey, Pa., also had a good word for "Inertol" for concrete protection. *T. R. Haseltine* had, with satisfaction, used aluminum paint three times since 1927 for sludge bed covers. And *Geo. H. Boone,* Sup't at Norristown, had experimentally proven that "Alco" flake aluminum paint for sludge beds was best, and also the least expensive per square foot of coverage. Elsewhere coal-tar paint had proved satisfactory since 1931.

During the discussion, the plant of Rahway, N. Y. (N. C. Wittwer, Sup't.) was paid high compliment for its effective and attractive painting. In the engine and pump rooms rubber walkway runners protect the neatly painted floors and reduced maintenance.

"Sewage Flocculation" by H. W. GEHM, Chemist, New Jersey Expt'l Station, New Brunswick, N. J.

Reporting on studies of mechanical flocculation of crude sewages (without chemicals) to improve removals by sedimentation, Mr. Gehm stated that the following combinations had been studied—(a) 30 min. flocculation + 1 hr. settling; (b) 1 hr. flocculation + 1 hr. settling; (c) 5 hr. flocculation + 1 hr. settling. In all combinations the effectiveness of preflocculation proved dependent on the make-up of the sewage.

As to return of solids, doubling the suspended solids improved the 30 minute flocculation effect. When return solids reached 5 times those in crude sewage, the effect was deleterious in all floccing periods. The presence of certain electrolytes (salts) improved floc formation, but no correlation had appeared between hardness or alkalinity of sewage and effectiveness of flocculation.

Observations brought the following conclusions—(1) The larger suspended solids serve no benefit as nuceli in floc-building and return sludge is of no benefit. (2) The important effect is that of coalescence of the very fine low gravity, otherwise non-settling or difficulty settleable. solids. (3) Within natural ranges, hardness of the sewage water has no influence; whereas, trade wastes of a floccing nature do. Such, for example, are iron wastes.

Dr. A. J. Fischer, The Dorr Company, in a prepared discussion (presented by W. A. Darby of the same company), cited comparative results in clarification efficiencies with preflocculation at several plants. He agreed that flocculation of settled sewage was not helpful, but that return of sludge had merit in some cases — especially when practicing wasting of activated sludge to the crude sewage ahead of flocculators.

On the floor, the question of flocculation with air came up. It was stated that combinations of air first, followed by paddles, had been very effective. In small scale studies paddles were the better, whereas in plant operation there was little to choose between the two methods.

M. B. Tark (Link Belt Co.) confirmed the last statement by saying that both seemed equal up to 1.5 hours, at least.

Linn H. Enslow raised the question of what possible economy could result from mechanical flocculation ahead of activated sludge aeration. It could hardly be conceived that any more efficient or economical floc production could be had than that prevailing in the first stages of activated sludge production—namely, the bio-flocculation and adsorption stage, in which sludge return had a real influence in "gathering up" peptized solids too finely divided to be agglomerated by mere collisions unaided by coagulants or active surfaces, such as sprinkling filter stones or activated sludge floc.

Mr. Darby replied that it was possible that activated sludge might be returned to the whole flow but only part of the settled sewage receive complete treatment. This for economy reasons, assuming sufficiency of such combination "super-primary" treatment and complete treatment of whatever fraction might be necessary to meet stream flow conditions.

Trickling Filter—Chemical Precipitation Combination

"The Improved Treatment Works of Butler, Pa." by JOHN T. CAMPBELL, The Chester Engineers, Pittsburgh, Pa.

Mr. Campbell's paper constituted an interesting story of design possibilities. At Butler chemical precipitation having proved insufficient treatment, secondary treatment was designed so as to take advantage of a pre-chemical treatment whenever required. The improvements, thereby, merely entailed the construction of trickling filters (8'-6" deep, 2 to 2½" stone) equipped with Dorrco Rotary Distributors. The design loading of 4,500 persons/acre-foot is double

that ordinarily practiced and was made possible by using chemicals ahead of the filters seasonally, or whenever the biological units show signs of fatigue from overload. Final settling of 1 hour is provided for in circular centerfed clarifiers. The chemical-filter combination proved less costly than activated sludge or complete chemical precipitaton.

Heated sludge digesters (two stages) equipped with P.F.T.-Downes Floating Covers have a design capacity of 3½ cu. ft./capita. Gas, compressed and stored in a pressure system, is utilized in producing all power to be required by this type plant. The unit is a 6 cyl. Transit engine direct connected to a 50 K.W. generator. Heat recovery is effected with a Simms Economizer on the engine exhaust and cooling water is recirculated through coils submerged in a final clarifier. Standby power service consists of a connection with a natural gas supply, which automatically cuts in before there is any gas deficency at the engine.

A "Triturator" shreds screenings for return to the crude sewage.

F. Woodberry Jones
Gascoigne Engrs.
Cleveland, O.
(Made Honorary Chaplain of P.S.W.A.)

Geo. H. Boone
Sup't. Sewage Treatment Wks.
Norristown, Pa.
(President, Eastern Section of P.S.W.A.)

"Operating Experiences at Butler, Pa." by T. R. HASELTINE, Sup't. of Treatment, Butler, Pa.

"Taking it on the chin" for having recommended such, Mr. Haseltine considered the ¾" openings between screen bars questionably close, causing the automatic cleaner to work too continuously. In operating the "Triturator", force feeding of accumulated screenings at long intervals had proved a serious mistake. Rags were thereby cut into ribbons, which later formed rag balls to give much trouble in sludge pumping. The "Triturator" is now operated less infrequently and the trouble has disappeared. Some study devoted to properly baffling the grit chamber had increased grit separation markedly. The grit, however, contains

Programmers
M. N. Stiles, Superintendent
Radnor-Haverford Treatment Wks.
Newton-Square, Pa.
John T. Campbell, The Chester Engineer
Pittsburgh, Pa.
T. R. Haseltine, Sup't. Treatment Wks.
Butler, Pa.
(John T. designed Butler's combination chemical precipitation-trickling filter plant. Only mistakes, said "T. R." were some pet ideas of his own.)

64% volatiles, and does not seem to improve with washing.

The cross-flow primary clarifiers, now converted to center-fed units, were made no more efficient in plain settling, but are so when practicing chemical pre-treatment. The practice is to recirculate sprinkling filter effluent to maintain continuous filter operation. Attempts at cuttng one of the two units out (resulting in a B.O.D. loading of 1200 lbs./acre/ft.) produced ponding and poor efficiency.

In sludge transfer to digesters, the decanting (concentrating) tank after 4 hour holding effects a volume reduction of between 50 and 75% for crude sludge, but far less for final tank (humus) sludge or chemical sludge. The supernatant from the digesters contains 0.3% solids. Gas production averages more than is needed. In digester control total alkalinity has meant more than pH value, and the practice is to maintain an alkalinity of 2000 parts or more in the sludge liquor, rather than control on the basis to pH values.

In the gas system the pressure type holder, with storage capacity only 15% of the average production rate, seems too scant for bridging the periods of low production rate and peak demand. The real bottle-neck seems to be the gas compressor, the capacity being too small to avoid wastage of gas during peak production periods. In consequence, there has been wasting of gas at certain hours and takings of natural gas at others. The minimum charge for the gas connection is $15.00 per month and this has never all been used in gas takings. On the other hand an electric standby charge would have been $22.00 per month. The power generated is almost all used in lifting sewage to the filters and recirculatng effluent. It has been calculated that $151.25 is the monthly saving when considering the cost of pumping with electric current.

Mr. Haseltine commented on his studies of lubricating oils for the engine. Somewhat surprising was the findings, in which a mid-continent oil had given better performance by actual test than a high grade Pennsylvania oil, and at ½ the cost. Oil is changed with every 500th hour of operation.

"Investigations Looking to the Treatment and Disposal of Acid Industrial Wastes" by W. W. HODGE, Industrial Fellow, Mellon Institute, Pittsburgh, Pa.

Professor Hodge, on leave from the University of West Va. to direct Mellon Institute investigations, looking to a means of reducing pollution of streams by acid iron wastes from the iron and steel industry, related pertinent considerations in this vast problem and the progress made to date. In all, consideration had been given 20 treatment schemes and 40 recovery methods of possible practical applicaton in reducing pollution by mine drainage and, more particularly, by waste pickling liquors of the steel industry. He explained the present disposal processes, which consist of leeching ponds, neutralization with lime and lagooning, the "Ferron" process of convertng the lime precipitated iron and calcium sulphate into insulating bricks, wall board, etc., and copperas (ferrous sulphate) production by improved methods, some of the newer working plants and pilot test plants being pictured. The newest continuous method consists of saturation with iron scrap and concentraton, followed by falling spray crystallization of the hot liquor in towers.

No. 1 Clinician
Harry M. Freeburn
State Health Dept.
Philadelphia

Honored Guest
Robert Spurr Weston
Consulting Engr.
Boston

Professor Hodge, in commenting on the adaptation of iron pickling liquor and salts as coagulants, referred to the use of pickle liquor and chlorine at the Akron, Ohio, filter plant, and a proposal to do the same at the Chicago Sewage Treatment Plants; the "Lyles' Sulfonation Proc-

ess", being developed by J. E. Lyles, Sup't. of Filtraton at Tampa, Fla., to produce ferric-sulphate; the "Keyes' Process" at Phoenix, Ariz.—similar to Lyles' process and involving sulphur dioxide, scrap iron, water and air; the Guggenheim process of oxidizing ferrous sulphate to ferric with air and sulfur dioxide; and the simplest of all schemes, the production of "chlorinated-copperas". In closing, he mentioned the valuable "Industrial Waste Guide" of the U.S.P.H.S. produced under E. S. Tisdale's direction at the Cincinnati station.

L. S. Morgan, Distr. Engr., Penna. Dep't. of Health, Greensburg, Pa. (new president of the Water Operators' Ass'n) emphasized the acuteness of the acid-iron waste problem. He reported that not fewer than 50 water supply streams in S. W. Penna. were acid during most of the year, adding permanent hardness and necessitating undue burdens of treatment costs and operating problems, corrosion, etc. Such wastes had cost Pittsburgh $200,000 for neutralization of acid ahead of slow sand filters. One 14 m.g.d. plant had actually used 27 tons of soda-ash and 12 tons of lime in a single day; and the sludge problem resulting was something further to cope with. Flood and stream flow control dams and navagation locks in the affected Penna. and W. Va. areas had been very helpful in reducing peaks of acidity and hardness. These wastes had only one possible attribute—namely, that less coagulant is required and the acid reaction is quickly destructive of pathogenic organisms—neither, however, being commensurate with the overall cost of acid streams in Pennsylvania.

The Clinic

("Doc" Harry Freeburn in Charge)

The "Sewage Works Clinic", introduced a few years ago, continues to be the most popular feature of the Association's program. A full half day was devoted to operator presentation of arguments for this and that method, correction of difficulties, public relations schemes, etc. Under

L. L. Gwinn, Consulting Engr. Altoona, Pa.
H. N. Herr, Estate Manager, Hersey, Pa.
C. H. Young, District Engr. Meadeville, Pa.

the effective direct and cross-questioning by H. M. Freeburn, "Director of Clinic", many otherwise obscure points are clarified and/or emphasized. Resulting, therefrom, an excellent and thorough guided discussion is attained.

"Cross Connections Between Water Supply and Sewage Equipment" was the topic introduced by J. R. Hoffert, Penna. State Dep't. of Health Engineer, who enumerated the several most likely hazardous connections — viz.: priming lines, pump seals, spray heads, hose lines, and meter drip lines. The most assured correction, said Mr. Hoffert, is the separate system scheme in which City water enters an elevated tank supplying the plant. The next is individual feed boxes to pump seals, etc., kept filled through float control valves.

Questions and answers brought out the facts—(1) that vacuum breakers are satisfactory if using a really complete breaker; (2) for priming lines the "Simplex" Disconnector fitting is an effective safeguard; (3) individual flush toilet tanks as line "breakers" at hazard spots, can be substituted for wholly separate systems.

F. S. Friel, Philadelphia Consulting Engineer (a past president of the Association) stated that water seals had no appeal to him because the safer and cheaper method for sewage pumps was the use of grease seals and wearing rings. (Ed. Note—Interestingly, nobody brought up the question—"Has a sewage plant ever been found responsible for back-syphonage?" Most frequently such plants are remote from any vacuum influence created on water supply mains. If there are proven danger cases W.W.&S. will appreciate such information in order to more concretely direct attention to this hazard than has heretofore been done.)

"The Oil and Grease Problem—Experiences with a Method for Degreasing Sewage" was discussed by Gordon J. Wiest, Chief Chemist, Sewage Treatment Works, Chester, Pa.

Mr. Wiest, until recently Chemist at the Lancaster, Pa. plant, enumerated the difficulties created by high grease or oil content of sewages, aside from plant appearance and foul nauseating rancid grease odors. The principal operating troubles included deficient settling of grease coated solids—particularly activated sludge floc; the coating of sprinkling filter stones and sand filters—(ponding, sealing, efficiency loss, and bad odors); heavy scum accumulations in digesters and poor supernatant liquor quality.

Chesterites

Manager, Chemist and Operators from the New Treatment Works of Chester, Pa. From the left, (1) *Harry A. Hayes, Manager;* (2) *Joseph Haines, Operator;* (3) *Gordon J. Wiest, Chemist;* (4) *Tom King and* (5) *Earl Clark, Operators.*

In particular at the Lancaster plant had grease been shown responsible for activated sludge deficiencies and sludge losses over the weirs. To remedy the situation, pre-aeration alone had been of but slight benefit. Having learned of the "aero-chlorination" scheme, developed by The Chlorine Institute, in which chlorine in small dosages seems to break the grease and soap emulsion and permit the air to effectively agglomerate and float the greases, ths method was put to trial with gratifying returns.

In brief the net results from studies made, comparing air with chlorine alone and chlorine plus air blowing, yielded removals as follows:

Treatment	Grease Removed
Detention (only)	1.6 No./m.g.
Aeration (only)	3.6 "
Chlorine (only)	3.5 "
Chlorine + Air	12.0 " *

* Removal of 80% as compared with 50% for air alone.

(1) *M. A. Clift, Nichols Engineering Co., N. Y. City;* (2) *John M. Snow, City Engr., Franklin, Pa.;* (3) *"Bill" Eastburn, Mathieson Alkali Wks., Phila.;* (4) *Paul D. Rogers, Asst. Engr., State Dep't. of Health, Harrisburg;* (5) *L. L. Longford, P.F.T.'s N. Y. Manager (see what he brought home from a vacation in the Carribean besides a swell tanning);* (6) *Alex. C. Williams, Director Public Wks. and Engr., Upper Darby, Pa.;* (7) *"Ted." Wilson, Penna. Salt Mfg. Co., Phila.*

(1) *John G. Gruss, Albright & Friel, Engrs., Phila., and J. V. Haworth, Boro. Secy. and Plant Mgr., Rose Valley*; (2) *L. R. Watson, Chief Operator, Meadeville, and C. R. Keatley, Engr., US.PHS., Greensburg, Pa.;* (3) *J. H. Reed and L. R. McCoy, Diamond Alkali Co., Pittsburgh;* (4) *J. R. Heinz and A. S. Wertz, Wertz Engineering Co., Reading, Pa.;* (5) *R. M. Heister, and S. W. Long, State Dep't. of Health, Engineers of the Williamsport and Meadeville Offices.*

Studies revealed that very little of the grease so separated in the primary tanks accumulated on the surface as scum—the greater part by far going down with the solids.

In watching the quality of activated sludge with apparently marked increase in settleability, improved structure and color, Mr. Wiest reported that its earlier content of 21.63% grease had decreased to 6.56%—both on the dry basis.

Concerning laboratory methods for grease determinations in sewage and sludge, several methods had been compared in follow-up studies, with average yields as follows when computing % grease removal by the primary tanks when employing "aero-chlorination".

Method	Reduction
Chloroform*	71.6%
Ethyl Ether	67.2%
Petroleum Ether	48.1%
Benzene	52.5%
Carbon Tetra Cl.	35.2%

* Standard Methods of A.P.H.A. suggest Chloroform and such was employed in plant tests reported in previously published articles.

(For details as to chlorine dosage, air volume and period, etc., the reader is directed to a paper by Mr. Wiest which is to be found in the Reference and Data Section of the May 1939 issue of W.W.&S., p. 277. The simplicity and economy of the method is an added justification for its recognition.—Ed.)

W. B. Hart, Engr., Atlantic Refining Co., Philadelphia, requested to tell what the oil companies are doing in waste treatment to remove oil, explained the simple subsidence and floatation schemes. (For an account of the method employed in the California oil fields see article by Humphreys and Rawn in this issue. —Ed.)

In considering percentage removals, a standard for the quantity of residual oil in the plant effluent had to be met regardless of the quantity in the influent. "Aero-chlorination" had appealed, but had been considered too costly for the vast volumes of oil field wastes—some plants handling as much as 160 m.g. daily. In regard to the problem of disposing of old crank-case oil, a movement is under way to collect and return such to refineries for re-working into lower grade products. It can be used as is on roads, in poultry houses, and mosquito control.

As to the method evolved for determining oil content of wastes, down to very low amounts, the following procedure had proved simplest and most effective.

(1) from a large sample floc out the oil with ferric coagulant.

(2) Filter and dry the precipitate.

(3) Extract with Ethyl Ether and distill off solvent.

(4) Measure oil extracted in capillary tubes.

H. W. Gehm (N. J. Exptl. Station) stated that petroleum ether was preferred at the N. J. Station, because chloroform dissolves too much that is not grease. Chlorine apparently removes other materials than grease alone, but "what" had not been identified.

M. B. Tark (Link Belt Co.) speaking from experience, stated that grease removals with aero-chlorination could only be determined by analysis of influent and effluent, since the grease was neither 100% in the scum or the sludge. At the same time he wished to warn against chlorine put through aluminum plate holders.

F. W. Jones reported like observations at Cleveland, Ohio. Of the 25 p.p.m. grease removed only 12 p.p.m. was recovered as scum and an equal amount in the sludge.

L. L. Langford (Pacific Flush Tank Co.) reported grease cloggage of trickling filters at Hamilton, N. Y.

In reply to questions, Mr. Wiest stated (1) that grease content of crude sludge had been increased from 10% to 15% during aero-chlorination; (2) that in the extraction laboratory work, the samples had been acidified.

Linn H. Enslow complimented Mr. Wiest's grease removal work at Lancaster, and also other work at that plant and reported that, as a result, Cleveland, Ohio, had equipped two plants for "aero-chlorination", and the design at Buffalo was altered to permit its use when desired. The most important installation was that at the new Dallas, Texas plant, as set forth in the feature article in W.W.&S. for June 1940. The scheme involves 4 minutes plain aeration to dispel H_2S gas and reduce chlorine demand, followed by 4 minutes of chlorinated air in sealed chambers vented through a stack. The scheme was designed for the dual purpose of odor control and grease separation ahead of trickling filters, designed for high or low capacity operation. In the odor control work "chlorinated-copperas" treatment is provided for, since the Dallas sewage exhibits an extremely high chlorine demand.

Here and There on the Campus

(1) *From left to right in this group are Hiller (Innis Speiden & Co.), Clift (Nichols Engineering Co.), Angell ("Water Wks. & Sewerage") and a couple of Joneses—F. Woodbury (rear view) and "Casey" (Simplex Valve & Meter's Sales Mgr.) who is Chairman of the Entertainment Committee;* (2) *One of several avenues of elms;* (3) *"Class Is Out"—Bogardus and Frank Roe nearest;* (4) *Carl Biekert, Inspector, Franklin, Pa., Myron G. Mansfield, Cons. Engr., Morris Knowles, Inc., of Pittsburgh and F. A. McCoy, Chief Operator, Franklin, Pa.;* (5) *Through the doorway of the meeting place;* (6) *W. B. Hart, Eng'r., Atlantic Refining Co., Phila. (his problems, treatment of refinery and oil field wastes); "Stan." E. Kappe, Engr., Chicago Pump Co., Phila., R. R. Cleland, San. Engr., Penna. State College.*

For tracing sources of oil entering sewers, Mr. Enslow suggested a scheme effectively employed in Houston, Texas. It consists of "planting" floating oblong blocks of white painted wood in manholes, these 'tell-tale" blocks being held by a cord. By examining these blocks and tracing the black stains up the sewer to the lateral involved, the polluter can be run down by similar tracing up laterals.

"Selling the Local Treatment Plant" was the topic introduced by M. N. STILES, Sup't., Radnor-Haverford Treatment Plant, Newton Square, Pa.

In the first instance, said Mr. Stiles, label the plant and place the sign prominently at the entrance roadway. Then get your town officials to come to visit the works, but only after making certain that all is in perfect order and operating smoothly. The next move is to cultivate the local newspaper editors and help by supplying "copy" about the plant, its features and performance in everyday language. Get articles published in the technical magazines and have reprints for distribution. Supply such reprints and pictures to the newspapers. Speak before civic clubs at every opportunity and use movies or slides to add interest. Interest the teachers and science students in the high-schools; tell the Boy Scouts what you've got and get them to the plant. Youngsters take home the story.

In all of this, adequate control of odors, good housekeeping and beautification are the important factors, regardless of what the process may be accomplishing. At the plant don't forget that a look at sewage filter film or activated sludge through the microscope becomes the center of attraction. And, forever keep cleaning up. And, don't overlook getting the State Engineers to visit you and make recommendations. (And, may we suggest, if they say something nice about your plant or its performance, get it in the local papers.—Ed.)

Geo. P. Searight, Boro Mgr., Carlysle, Pa., (new President of the Association) said that the Carlysle plant makes a practice of publishing in the local paper that house plants can be left at the sewage works for care while the owners are away. Further, the Iris Show at the sewage plant was the best in the vicinity, garden clubs coming to see it. Many cut flowers were supplied from the plant for Memorial Day services and many knew about it.

F. S. Diefendorf, Supt. Treatment Works of Erie

C. L. Seibert, Industrial Waste Div. State Dept. of Health, Harrisburg

T. D. Woodward, Plant Supt. Treatment Works of Conshohocken

"Experiences with a Small Mechanical Activated Sludge Plant" were set forth by LEWIS L. GWIN, Consulting Engineer of Altoona, Pa.

Mr. Gwin described the little plant of Williamsburg, Pa., treating 235,000 gals./day from 1800 people, and consisting of Primary Settling Chicago Combination Aerator-Clarifiers and P.F.T. floating cover sludge digesters of 6 cu. ft./capita capacity. Pictures revealed a very compact attractive plant, run by an untrained operator after 30 day instruction by a Chicago Pump Company engineer, per contract. The wasted sludge is thickened in small concentrating tanks.

Daily routine tests consist of a centrifugal test for solids in the mixed liquor, a volume settling test for sludge index, and dissolved oxygent present in the aeraton compartments. The oxygen input (power consumed) is regulated by program clock effecting on-and-off operation of the blower, with continuous aeration for only 30% of the time. Suspended solids in mixed liquor found best when carrying only 600 to 650 p.p.m. in summer and 800 to 850 p.p.m. in winter. Whereas the sludge index was always high, the effluent remained good at an average of 5 p.p.m. suspended solids and 94% B.O.D. reduction. In sludge control there is no return problem in the combination unit, solids being controlled by amount of sludge wasted twice daily to the concentrators. Digested sludge is dried under glass covers.

As to operating costs, including operators' salary and pumping, such had been $2400 per year. The plant cost $65,000 complete.

S. E. Kappe (Chicago Pump Co.) was asked why with a combination unit construct costly primary tanks. His reply was that of advantageous smoothing out load on the aerators, and especially so because of intermittent pumping at Williamsburg. As to the proper amount of suspended solids to maintain, defining limits was not possible, experience showing that somewhere between 300 and 2700 p.p.m. the optimum quantity would be found.

"Problems of Winter Operation" was the topic introduced by C. F. GRACE, Sup't. Sewage Treatment, Polk State School, Polk, Pa., who, having passed through 30 winters of sewage treatment, very assuredly was not lacking in experience. To overcome ice build-up on tracks of mechanical screens, resulting in stopping of the mechanism, he had with success swabbed the trouble spots with machine oil (thinned with kerosene) to convert the hard ice into mush. Freezing up of scum in Imhoff gas vents and blocking free gas escape had been remedied by leaving pieces of 2 x 4s in the vents. (Exactly how this was done was not disclosed and anyone experiencing vent freezing troubles may get the details by writing Mr. Grace.—Ed.) Another difficulty had been choking of air intake filters with frost. How this trouble was overcome, if it was, he did not say. Freezing of a syphon dosing counter was overcome by enclosing it and burning an electric bulb inside of the housing. Perhaps the most interesting and unusual experience reported by Mr. Grace was an experience with an electric motor freezing up during 15° below Zero weather.

Mr. Grace was very proud of his chlorinator, now doing service for 14 years with a total maintenance cost of only $18.00 in that period. He thought that to possibly be a record.

M. N. Stiles, Sup't., Radnor-Haverford Treatment Plant, told of heating tray-water for his chlorinator by installing a gas-burning copper heating coil. He figured that gas at a sewage plant was cheaper than using the electric coil heater, or burning electric bulbs under the chlorinator tray.

A question was asked concerning what to do to prevent ice building up on the walls of a revolving distributor filter and eventually stopping the arms. The most practical solution seemed to be plugging of the end holes of the arms. If not sufficient, plug the nozzle nearest the end of the distributor arms.

At this point Mr. Freeburn was given a rising vote of thanks before the President's gavel sounded the end of the meeting.

TREATING INCRUSTED WELLS

Proves Effective Means of Increasing Production at Critical Periods

By JOHN R. GOETZ, Supt. and F. L. COVENTRY, Chemist

WATER DEPARTMENT, MATTOON, ILLINOIS

CORROSION is a chemical attack on any material which changes its form or breaks it down—in short, "an eating away" of the material Someone has very aptly explained corrosion as the process of the return of a metal to the composition in which it is found in nature—in other words, a return to nature through natural processes. For example iron ore and rust are one and the same chemically; zinc and copper return to the carbonates. Mercury, gold and platinum being in their natural state, do not rust or corrode.

Incrustation is, on the other hand, a deposition of material. Incrustation with which this paper deals results in the clogging or stoppage of a well screens and or water bearing formations. It is the result of deposition or collection of material in and about the openings of the well screen and the voids of the water bearing sands or gravel. It is usually hard and cement like; but it may be soft and gummy. Where the water is of an depositing nature, incrustation will appear sooner or later, and it is of importance to give careful consideration to all methods for the prevention or retarding of incrustation.

Cause of Incrustation

In a large number of cases incrustation will become so marked that it becomes necessary to take measures to treat the wells. All ground water normally contains more or less free carbon dioxide. The capacity of water to absorb and hold this gas depends upon temperature and pressure—the colder the water and the greater the pressure, the more it will absorb and hold. Pure water itself can take only a very small amount of calcium carbonate (limestone) into solution, but when water containing free carbon dioxide moves through the ground it can take into solution considerable quantities of calcium carbonate and other incrusting materials, including iron.

The water lowers in a well when the well is pumped, thus producing the differential in head called "drawdown." Because of this reduction in pressure within the zone of drawdown more or less of the carbon dioxide is released from the water and, with this gas released, the water is unable to carry its full load of lime-like material which it has had in solution. Some of it is precipitated, or dropped, and is deposited around the well-end. Due to the fact that the conditions for the release of the gas are most favorable at the well-end, the greatest amount of incrusting material is deposited as a cement-like material on the screen, and in the sand or gravel around the screen. Naturally such choking deposits cause a marked decrease in well yields and something must be done about it.

Well Treatments to Boost Yield

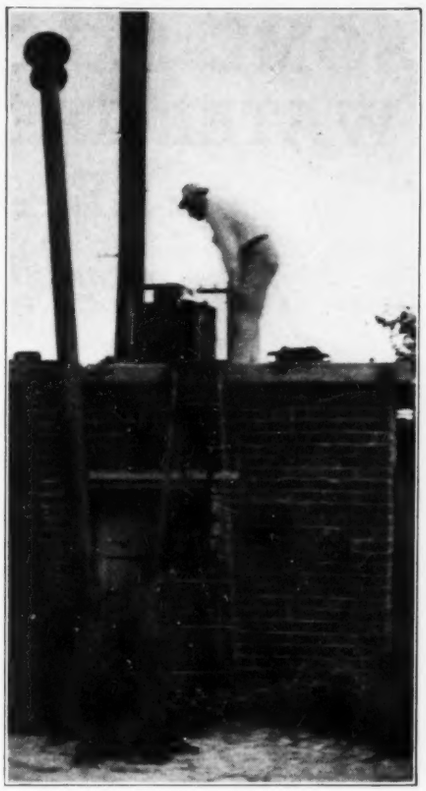
In general, there are two successful methods for treating incrusted wells, namely, (1) pulling the incrusted screens, treating them for the removal of the incrusting material and resetting them; (2) treating the screens without pulling them. It is obvious that the first method is effective but it involves considerable risk and labor. If the incrustation is very hard it sometimes requires immense power to withdraw the screen, occasionally resulting in breaking the pulling pipe, or damaging the screen. There is also some risk involved in replacing the screen after treatment. Treating the screens without pulling them with acid is not a new discovery so far as the use of the acid is concerned, yet we found very little information and

Well Treatment Set Up

The drop pipe is up and swung to one side out of the way. The rubber hose is down in the well, the lower end resting on the bottom, and the first charge of acid is applied. The hose is hung from the wire seen by the rule, and is drawn up a foot at a time during the emptying of the carboy sufficiently to completely fill the screen. The drop pipe is returned to the well and twelve hours or so later the well is pumped free of residual acid and returned to service. Note the carboy tubing arrangement, and the bulb for starting the acid syphoning into the dosing drop hose.

less experience by water works operators in the use of the method.

Our treatment of a well involves the use of muriatic acid (hydrochloric acid of commerce) which can be purchased in convenient containers or carboys, usually of 12 gallons capacity. Full strength acid should be used and at least enough to fill the screen. As shown in the illustrations a length of garden hose about ¾ or 1-inch in diameter, and of sufficient length to extend to the *bottom* of the well, should be obtained. Provision should be made for wiring the hose in place as to depth in the well. The hose is lowered until it is within a foot or so of the bottom of the screen. If the screen is more than three or four feet long it is well to add enough acid to fill one foot of screen, then lift the hose one foot and add more acid. (Note—in one picture, you may see the rule and the wire which is fastened to the hose down in the well.) Into the upper end of the garden hose is taped (tire or friction tape) a length of small rubber tubing. The other end is connected to the carboy by means of a glass tee. A rubber syringe bulb is also attached to the tee to enable the operator to prime the acid "syphon." The amount of acid for each foot of screen is calculated ahead of time, and can be checked by the rule as the level drops in the carboy. Example: A 10 inch screen will require about four gallons per foot, or one third of the height of a 12 gal. carboy.



A Roof Job

The senior author is watching the dropping acid level in the carboy—to "say when."

The hose end is lowered to the bottom and worked upwards in order to produce as little dilution of the acid as possible. The acid being heavier than the water, will displace the latter, but it mixes with water so readily that it is easily diluted.

The acid charge is permitted to stay in contact with the screen for twelve hours, during which time the drop pipe and pump may again be installed ready for operation. Since we have a lime-soda softening plant we merely start the well pump and allow the operation of the plant to compensate for any excessive acidity in the first water coming from the well.

Our experience has shown that as much as a 40% increase in well production followed the acid treatment of the well.

A Few Precautions

Necessary conditions for acid treatment of wells are:

1. The well screen must be constructed of metal which will not be damaged by acid. Brass or bronze screens require muriatic acid, while iron requires nitric acid.

2. The screen must be constructed of one metal to avoid establishing rapid galvanic corrosion which would greatly damage the screen.

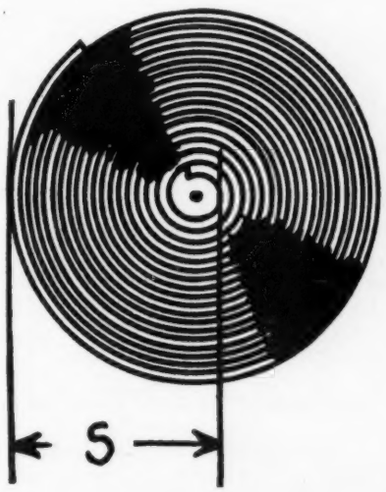
3. There should be some definite knowledge of the kind of incrusting material so as to determine the proper acid. Samples of incrustation taken from other wells in the locality are usually available. In the absence of such samples an analysis of the water will usually indicate the proper procedure.

QUICK WAY TO ESTIMATE LENGTH OF MATERIAL IN ANY ROLL*

Most of us are users of considerable material that comes in rolls—paper, hose, belting, cables, wire, etc. —and the question often arises, "How much material remains in that roll?" Or, "Does the original roll contain full length?"

There are numerous formulas for computing lengths in rolls, but I find that all of them are more or less complicated. We are told to find the outside diameter, the inside diameter, then subtract, multiply, and do various other things, and finally we get the answer.

Here is a simple rule of my own derivation which I contend is the simplest possible: Make the one measurement "S", as shown in the sketch herewith, in inches. Then count the number of turns. Multiply the two together and then multiply that by 0.2618. The result is the length of material in feet.



For example, if the distance "S" is 10 inches, and the number of turns is 10, the roll contains 26.18 feet.

This holds true regardless of whether the material is paper, leather, or anything else. The thickness of the material does not make any difference.

To check the rule, take an instance where we have only one single turn of belting, the distance "S" being 10 inches. The roll, then, is a true circle, and the distance "S" is the diameter of that circle. The length of the belt, of course, is equal to the diameter times 3.1416 or, 31.416 inches. Now divide that by 12 inches and you will get 2.618 feet, as per the above rule.

Even if the roll is so tightly wound that there is no visible hole through it, the rule still holds true. And, ditto, if it is loosely wound.

*Contributed by W. F. Schaphorst, M.E., Newark, N. J.

Entrance Reading's Filter Plant

SOME EXPERIENCES IN WATER TREATMENT AT READING

By WALTER STROCKBINE
Chemist*
READING, PA.

The Author

THE new Maiden Creek Filter Plant, at Reading, was put into operation in November, 1935. Alum was used as the coagulant and after filtration, the water was aerated to remove free carbon dioxide (CO_2) and then lime treated to keep it between 0 and 1 ppm. Good coagulation was not obtained during cold water periods nor when the water contained a large amount of organic matter. Baffled mixing channels of around the end type are used. The baffles being of concrete made it difficult to change velocities to obtain the most effective mixing and floc formation.

Copperas and Lime

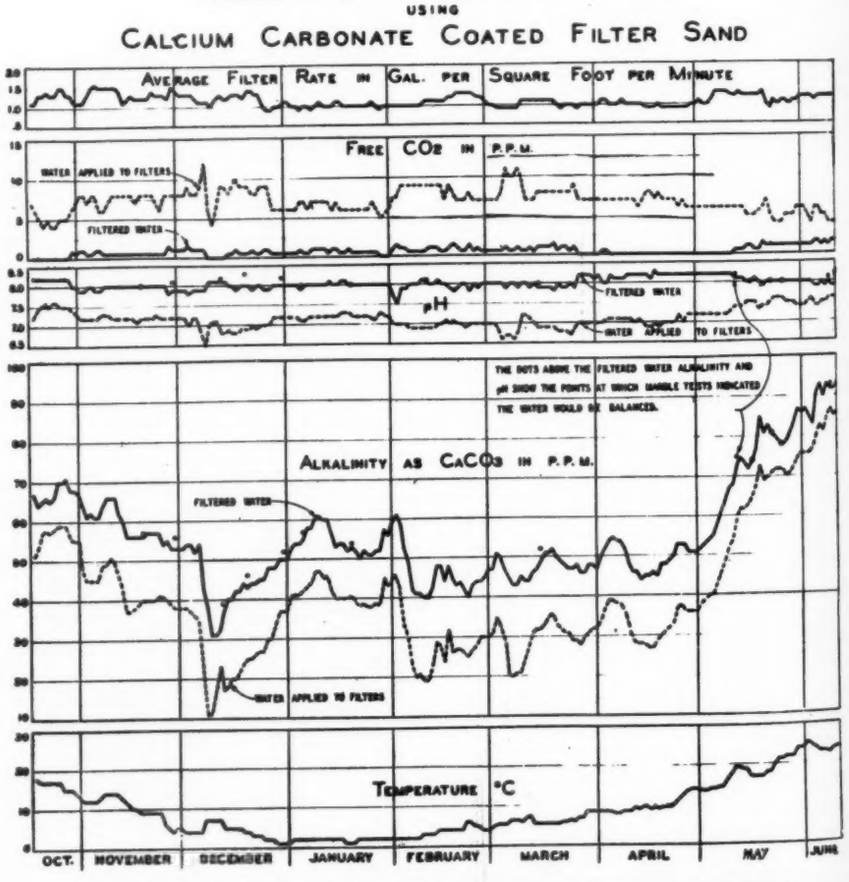
A great many laboratory tests were tried, using about everything claimed to aid coagulation which had appeared in the literature. It was found that by using copperas as the coagulant, and lime to soften, the precipitated Ca CO_3 acted as a nucleus for floc formation and greatly improved coagulation. This treatment was started in the plant in July, 1937 and continued until January, 1938. While on this treatment, a large number of tests showed no drop in alkalinity in the distribution system, proving that there was no $CaCO_3$ deposited there. The sand grains, however, became coated. The original freeboard of thirty-seven inches was reduced to twenty-three inches while on this treatment.

$CaCO_3$ Coated Sand Stabilized Water

During the winter months, the water is not as hard as in the summer and there is very little organic matter present. It was decided to change to alum treatment in the winter so that the CO_2 in the water would reduce the carbonate coating on the sand. It was found that this coating reacted with nearly all of the CO_2 in the water applied to the filters. The results are shown in the accompanying graph. All of the factors which it was thought would influence the CO_2 in the filtered water were considered. The dots above the filtered water alkalinity and pH show the points at which marble tests indicate the water $CaCO_3$ saturated and stabilized. The coating on the sand is brown in color but contains only .046% iron. During the period when the coating was being dissolved, the filtered water never contained more than .02 ppm. iron.

Super-chlorination and Dechlorination with Ferrous Sulphate

Although the copperas and lime treatment produced better coagulation than alum, good coagulation was not obtained when the water contained



CO_2 Removal and Stabilization of Water by $CaCO_3$ Encrusted Sand

(The World's Largest Enslow Stability Indicator. Note how closely the marble test checks with the stabilization in passage through the $CaCO_3$ plated grains.)

TABLE I—SUPER CHLORINATION—COPPERAS AS DECHLORINATING AGENT

August 18, 1939. Few Anabaena Present

			Cl_2 Applied To Raw Water			
0 lbs mg 0 ppm	10 lbs mg 1.20 ppm	20 lbs mg 2.40 ppm	30 lbs/mg 3.60 ppm	40 lbs mg 4.80 ppm	50 lbs mg 6.00 ppm	60 lbs mg 7.20 ppm
			Residual After 2 hrs. Contact			
	.00 ppm	.63 ppm	.63 ppm	1.50 ppm	2.52 ppm	3.46 ppm
			Absorbed During 2 Hrs.			
	1.20 ppm	1.77 ppm	2.97 ppm	3.22 ppm	3.48 ppm	3.74 ppm
			[At this point were added 200 lbs./MG copperas and lime at the inlet of the 2 hr. settling basins.]			
			Odor of Settled Water			
2V - 3V	2V - 3V	1V - 2V	0 - 1g	0 - 0	1M - 2M	1M - 2M
			(Figures on left cold test; on right hot test.)			
			Turbidity of Settled Water			
4.5	3.0	2.5	2.5	2.3	2	1.6

TABLE II—ODOR CAUSED BY ANABAENA DESTROYED BY SUPER CHLORINATION

August 28, 1939

			Cl_2 Applied lbs./mg.			
0	10	20	30	40	50	60
			Odor of Settled Water			
3d - 4d	2d - 3d	2d - 3d	1d - 2d	0 - 0	0 - 1M	1M - 2M
			(Cold odor left; hot odor right)			
			Turbidity of Settled Water			
3.5	3	2.8	2.5	2.0	1.6	1.5

much organic matter. Pre-chlorination had been used during such periods, up to 1939. A dosage of ten pounds per million gallons was used for this purpose. While chlorine in this amount greatly aided coagulation, it very often intensified odors that were present or set up new ones. It was decided to try super-chlorination and let the copperas serve as the dechlorinating agent, and at the same time form chlorinated-copperas for improved coagulation.

Laboratory tests were run during 1939 from June to the end of the year. Results shown in tables No. 1 and No. 2 are typical of the results found in a great many laboratory tests. The odors are expressed in terms used in Standard Methods of Water Analysis prior to 1935. Tests in the laboratory have shown that copperas ($FeSO_4$) will react to theoretical completion with the chlorine in these dilute solutions, viz.: $FeSO_4 + Cl = FeSO_4Cl$ which is the well known reaction in the production of chlorinated-copperas when mixing strong solutions of copperas and chlorine, this improved coagulant first being applied in water treatment by Enslow and Hedgepeth at Elizabeth City, N. C., and later by M. C. Smith at Richmond, Va., and at other plants since.

The Wallace & Tiernan Co. loaned us two 300 lb. chlorinators for a plant scale experiment. These were set up at a point on the conduit carrying the raw water to the plant. Thus a two hour contact period existed before the copperas was applied at the plant. These were put into operation on August 15, 1939. The chlorine dose applied was the amount found to be the best dose in the laboratory. This varied from thirty to forty pounds per MG.

The results found on a plant scale were the same as found in the laboratory. All taste and odors existing in the raw water were reduced very close to zero. During this period, there had been a growth of Anabaena in the lake. The total number of bacteria were high in the settled water at the start of this test. Later two pounds per MG of ammonia was applied just before the copperas. The end sought was attained; much of the excess chlorine was changed to chloramines, in which form the copperas did not reduce the residual. The chloramines persisted through the basins, to hold back what was apparently an after-growth in the dechlorinated water in the basins and filters. By so "fixing" the residual (in effect dechlorinating with ammonia by converting the excess free chlorine to chloramines which then persisted through to the filters) the total count of the settled water dropped to an average of about 5 per milliliter.

* Until recently Chemist in the Reading Water Department.

AN ALGAE "BLACK-OUT"

Otherwise an Algae Control Scheme With Activated Carbon*

By WM. T. BAILEY
Chemist
CITY WATER WORKS
COUNCIL BLUFFS, IOWA

THE scheme of handling the water adopted in our plant some years ago (1) was never completely satisfactory because of the fact that it left the two primary coagulation basins with no provision for preventing algae from developing and growing therein.

These basins are two of a unit of four having sloping outer walls and vertical division walls, common to adjoining basins. Each of the two is 222 feet long, 114 feet wide and 20 feet deep.

This arrangement permits their division wall, which has a forty foot weir at the south end, and the vertical walls at the north end, to receive sunlight for much of the day.

Water leaving the first baffled mixing chamber, after receiving an application of aluminum sulphate and hydrated lime, enters the first basin through two 24 inch pipes at the northwest corner. These pipes are approximately 8 feet below the surface. Baffles placed in front of them divert the water upward to break horizontal currents and spread the water uniformly as possible over the corner of the basin in order to secure maximum settlings of the coagulated material. As soon as the velocity drops below the carrying point the coagulated silt appears to drop almost vertically; leaving a very sharply defined "break line" within a radius of 25 to 50 feet of the inlets.

From this break line the water travels diagonally across the basin to the weir in the southeast corner where it enters the second basin. It is taken from the second basin through a 30 inch outlet pipe in the northwest corner to the next set of basins across the street.

Turbidity of the coagulated water entering the basins varies from 150 to 1,500 p.p.m. during the summer months; monthly averages being 150 to 400 p.p.m. At the break line the turbidity drops sharply to 50 or 60 p.p.m.; at the weir 20 to 60 p.p.m.; while at the outlet the turbidity averages 10 to 50 p.p.m.

The Author

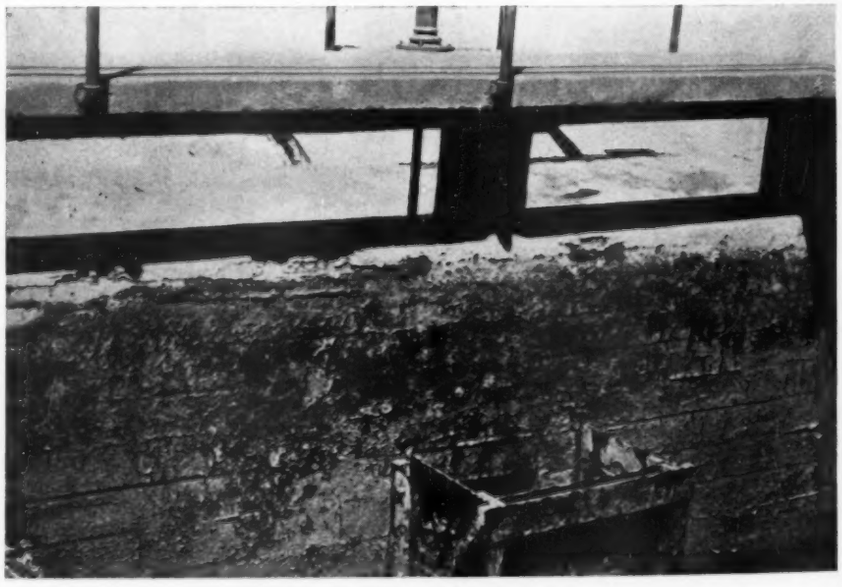
Basins Provide 12 to 20 Hours Detention

The combined theoretical detention time of the two basins varies from 20 to 40 hours, with varying rates of pumpage met with during the summer months. Actual detention time has never been determined except by observation of the spread of carbon across the basins, and appears to be 12 to 20 hours.

In past years such forms of algae as Oscillatoria and Microcystis, accompanied by various diatoms, protozoa, etc., grew prolificly along the basin walls to depths as great as 12 or 14 feet. Occasionally growths of free floating forms such as Asterionella and Sphaerocystis became profuse enough to impart tastes and odors to the water.

Attempts to prevent these growths by chlorination of the water entering the basins were unsuccessful because of the extremely high chlorine demand of the coagulated material. Chlorination also appeared to result in rapid putrefaction of the sludge settling in the basins, which greatly increased the odor problem. Addition of ammonia ahead of the chlorine failed to solve the problem.

So, until 1939, our treatment consisted of periodical applications of copper sulphate. The method used was the dragging of bags of the material along the walls for treatment of attached forms, and dragging the entire surface for free floating forms. Results were never very satisfactory along the vertical walls because the rapid settling of the copper made it virtually impossible to secure a concentration, in contact with the algae, of sufficient strength to completely remove the growths. Copper sulphate applications usually required an increase in activated carbon dosage in order to remove tastes resulting from liberation of algal oils, the activated



Before the Effective "Black Out"

This is how our weir wall between the two basins looked in May of last year despite the dragging of the wall surfaces with copper sulphate at intervals of two weeks prior thereto. The growth was predominantly Oscilliatoria.

* The author tells us that this novel scheme of employing "black turbidity" in coagulating basins was first applied in May 1939 at Council Bluffs and has since proved equally effective in other plants.—Ed.

carbon being applied in the 30 inch outlet pipe to the filters from 1933 to 1939.

As early as 1934 we had observed that "whenever sufficient activated carbon was applied to darken the water, no algal growths took place in reservoirs where the carbon remained in suspension"(2).

An attempt to prevent algal growths in these two particular basins by applying activated carbon to the coagulated water entering the first basin met with failure. This might have been expected because of the fact that the carbon was dragged down the coagulated silt.

Attempts at Securing a Carbon Blanket

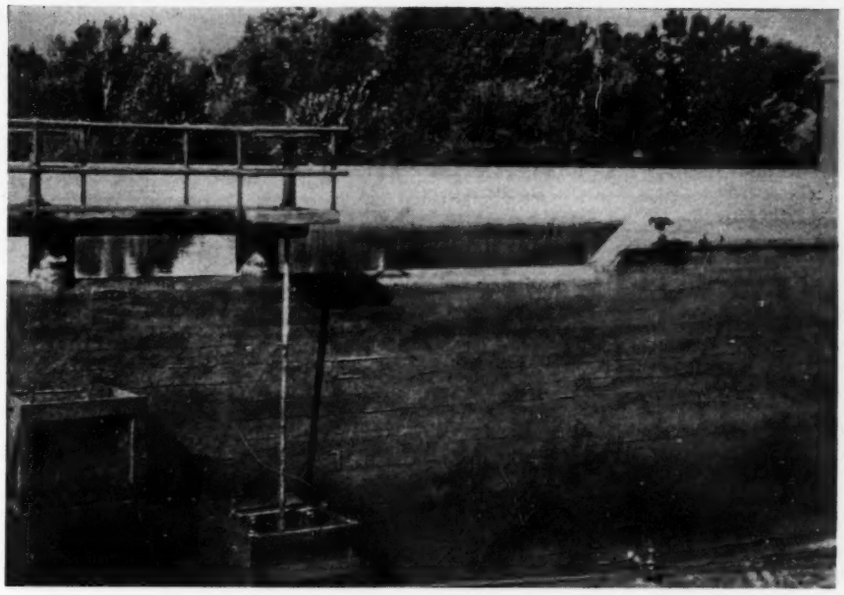
In the spring of 1939 we conceived the idea of coating the water with a blanket of carbon particles by sprinkling the dry material directly on the surface. While this method worked successfully at times, it was not completely satisfactory because of wind action blowing carbon all over the entire plant at times; no blanket being secured with unfavorable wind conditions. Also there was a tendency for the material to pile up under the spout of the feeder until a sufficient mass of the material had accumulated to overcome the surface tension of the water, when the entire mass would sink to the bottom.

Finally an attempt was made to secure a carbon blanket by discharging a suspension of carbon horizontally along the surface of the reservoir just outside the break line. The carbon was fed with a Booth type dry feed machine, and the suspension taken from the solution bowl with a 1 inch ejector, and discharged through a 2 inch hose. After considerable experimentation it was found that when the discharge hose were carried to the northeast corner of the first basin and the hose turned so that the carbon suspension was discharged directly toward the inlets in the northwest corner the suspended carbon traveled along the surface to the break line, where it was spread over the entire surface of the basins.

This application was begun June 5, and continued until the basins were emptied for washing in October. During this period no copper sulphate was applied to the first basin, and but two applications in the second; both being the result of lowering the carbon dosage too far while attempting to find the minimum dosage required.

Operating Data

The following tables give a comparison of turbidities, activated carbon and copper sulphate used during the summer months of 1938, 1939 and up to July 16, 1940. During 1938 and May 1939 and May 1940 activated carbon was applied in the 30 inch outlet pipe in these basins. Since that time it has been applied to the surface of the first basin as described in preceding paragraphs.



After the Algae "Black Out"

This is the same weir wall as in the "before" view. The "Black Out" treatment described in the text had been in use since June 5th, i.e., 118 days during our worse algae trouble period. Note the black line to the right of the weir and on the columns under the walk way. It is the mark of the floating carbon "blanket."

TURBIDITIES IN P.P.M.

	Inlet			Weir*			Outlet		
	1938	1939	1940	1938	1939	1940	1938	1939	1940
May	398	230	268	48	43	29	29	24	20
June	285	270	350	57	55	51	37	34	33
July	255	275	338	55	58	44	43	41	33
Aug.	245	190		53	38		40	30	
Sept.	290	160		56	30		45	22	
Oct.	250	150		37	20		27	13	

* Over which the water passes from one basin to the other.

	Activated carbon (lbs./M.G.)			Copper Sulphate (total pounds)		
	1938	1939	1940	1938	1939	1940
May	9.4	9.3*	13.1	210	250	180
June	15.1	11.9*	11.7	260	none	none
July	12.2	16.8*	17.4**	220	none	none**
Aug.	9.5	11.2*		120	30	
Sept.	8.2	6.7		100	40	
Oct.	5.8	6.1		none	none	

Note*: Cliffchar used during May, June, July and two weeks of August, 1939. Aqua Nuchar used all other times.
Note**: Figures are for first fifteen days only in July 1940.

Carbon dosages show that no increase in activated carbon is required when applying directly to the surface of the basins for prevention of algal growths by the "black-out" method. Copper sulphate is eliminated by applying sufficient activated carbon. And, surprisingly, there apears to be little, if any, difference in the algae inhibiting power of Aqua Nuchar over Cliffchar despite the greater suspendibility of the former.

These tables also show the most trouble from algae to be encountered during the months of May, June, July and August; as indicated by decreasing copper sulphate during August, September and October.

Results

The heavier dosage of activated carbon during June and July of each year is the result of raw water conditions, and the increased dosage during those months completely eliminates algal troubles with our present method of application.

Our experience has been that dosages as low as 6 pounds per million gallons very satisfactorily inhibits algae in the first basin, but the dosage must be maintained at about 10 pounds per million gallons to give satisfactory inhibition throughout both basins. Dosages of 14 to 16 pounds give excellent results, and on occasions when it is increased to 20 pounds any wall growths, which may be present, actually peel off.

No stabilization of sludge resulted in these two basins during this treatment, although results through the remainder of the basins was no different than previously (1) (3). This would indicate that both Cliffchar and Aqua Nuchar remain suspended in the upper portions of the basins when applied horizontally on the surface.

The term "Blacking Out" was that suggested by a local newspaper reporter when photographing the application equipment for a newspaper article. It seemed so apropo that we adopted it and passed it along to others interested in the application.

(1) Jour. A.W.W.A., Vol. 27, No. 4, Page 470.
(2) Jour. A.W.W.A., Vol. 27, No. 4, Page 468.
(3) Jour. A.W.W.A., Vol. 29, No. 3, Page 394.

Something to Boast About Seeing is Believing

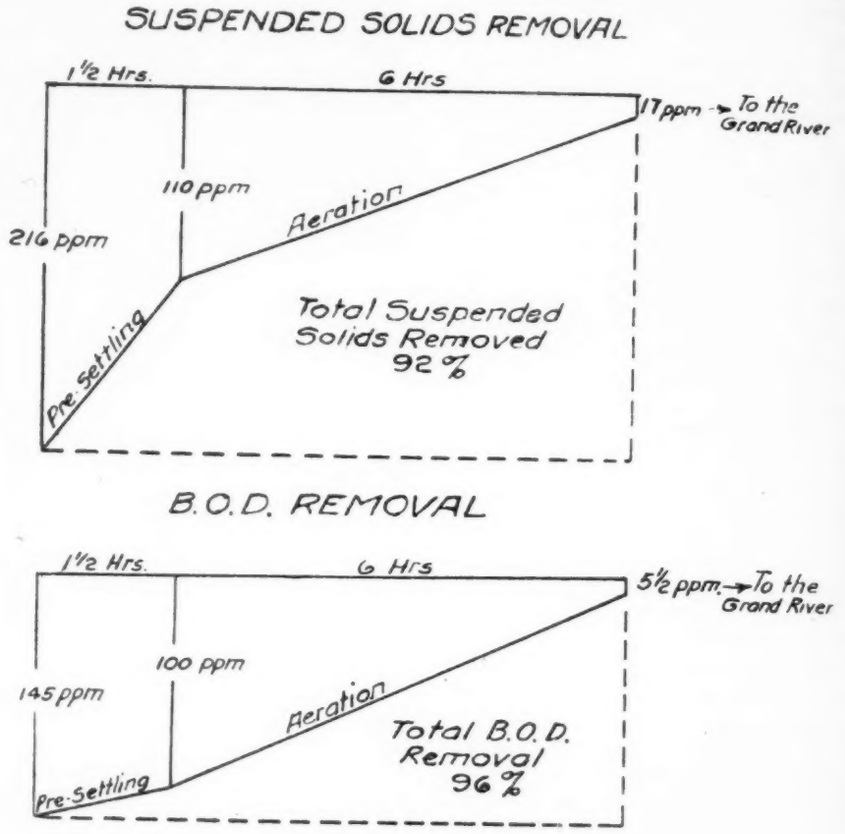
YE ED thought that he had seen the best performing activated sludge plant in existence when he observed the plant of Lodi, California. But this was some time ago and since, we understand, canning wastes (or is it winery wastes) have played "hobb" with Lodi's plant, seasonally at least. However, we will not forget the remarkable vigor of the organisms in Lodi's sludge nor the consistent good behavior of that plant during the period that we had an opportunity to study it.

About a year ago, Ye Ed had to admit that he had discovered another "Lodi"—which is to say that he will not concede that there is an activated sludge plant on American soil that surpasses that of Jackson, Michigan, in consistent behavior or its remarkable performance.

We have often since thought of Jackson with its final settling tanks utilized as aquariums and filled with gold-fish thriving on sludge and visible 8 to 10 feet down in the clarifiers. If that impressed us, how much more should the general public be impressed with what is visible at the screen-chambers and what it sees turned out at the end of the process.

A short time ago we received the Annual Report of A. B. Cameron, Sup't. of the Jackson plant. Two diagrams from it are here reproduced, and these pictures are worth the proverbial 10,000 words. Just take a look at them.

The balance of the story is told in terms of averages by months and for the year. The following are some of the annual averages for this plant which serves 55,000 pop.; treats 7.23 m.g.d. average flow.



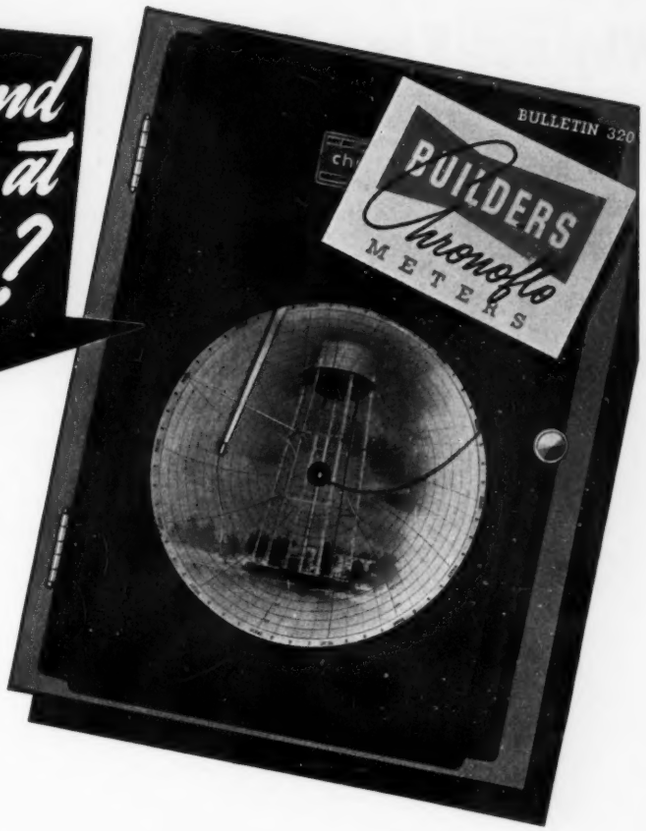
Air used (c.f./gal.)	=	0.74
KWH per mg. treated	=	614
Operating cost per mg.	=	$17.92
Total Cost per mg.	=	$36.36*
Cost per capita per year	=	$ 1.74*

(* All fixed charges included.)

We are willing to submit this data as something of a record as to performance, in terms of purification and in costs, for plants anywhere near the same size in respect to capacity or flow treated. If any reader can produce a better story the pages of WATER WORKS & SEWERAGE are open to him. Let's look at the records!

Believing that his plant should boast an appearance in keeping with that of its "products," Sup't. Cameron has under way a $165,000 W.P.A. landscaping and beautification project, involving 868 trees, 10,000 shrubs, and an underground (effluent fed) sprinkler system covering the entire plant area. The project was made possible by the availability of funds impounded from the appropriated funds for plant operation after deducting actual expenses. Very soon Jackson can invite the World to come in and see a Sewage Treatment Works *"ne plus ultra."*

Are your tanks and reservoirs working at only 50% capacity?



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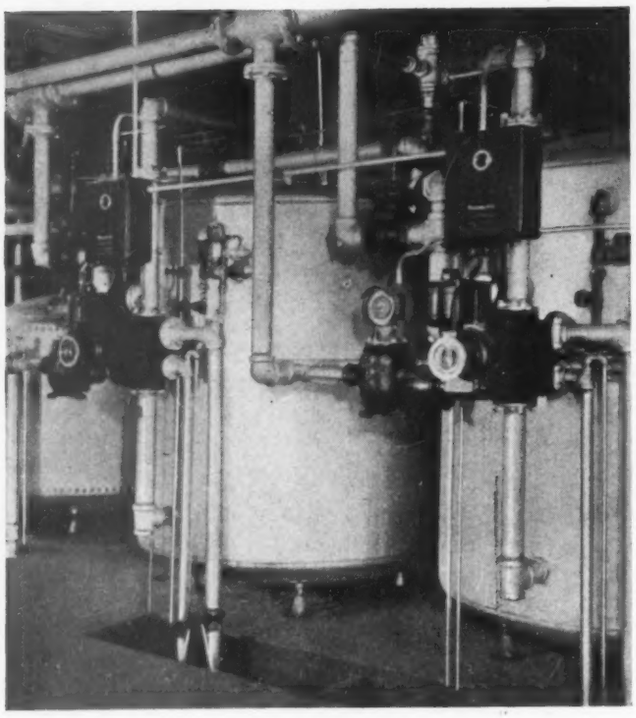
Why not Keep Up with the Jonesboros?



A FEW years ago a city near Jonesboro, Illinois, installed a water-treating plant. By comparison, the Jonesboro water supply—with a hardness varying from 14 to 22 grains per gallon—seemed very unsatisfactory.

The people of Jonesboro did something about it. They investigated Permutit. The two Permutit automatic Zeolite Water Softeners shown here were installed. Hardness was reduced to 5 grains per gallon for the 200,000 gallons treated every day. Now Jonesboro has a water supply to be proud of!

HOW ABOUT YOUR CITY?

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WATER CONDITIONING HEADQUARTERS

MEETINGS SCHEDULED

Sept. 3-5—College Park, Md. (University of Maryland)
Maryland-Delaware Water & Sewerage Ass'n. Short School for Water and Sewerage Operators. Chairman, Carl A. Hechmer, Washington Suburban Sanitary District, Hyattsville, Md.

Sept. 5-6—Charlottesville, Va. (University of Virginia)
Virginia Section A.W.W.A. Sec'y., H. W. Snidow, 119 State Office Bldg., Richmond, Va.

Sept.—Wahpeton, North Dakota
North Dakota Water & Sewage Works Conference. Sec'y.-Treas., Lloyd K. Clark, State Dep't. of Health, Bismarck, N. D.

Sept. 11-13—Ann Arbor, Mich. (Univ. of Michigan Union)
Michigan Conference on Water Purification. Sec.-Treas., R. J. Faust, Michigan Dept. Health, Saginaw, Mich.
(Meeting Jointly with)
Michigan Section A.W.W.A. Sec.-Treas., M. N. Gerardy, 803 Water Board Bldg., Detroit, Mich.

Sept. 16-17—Denver, Colo. (Cosmopolitan Hotel)
Rocky Mountain Section A. W. W. A. Secretary, R. V. Howe, State Office Bldg., Denver, Colo.

Sept. 16-17—San Diego, Calif.
California Sewage Works Association. (13th Annual Fall Convention.) Sec'y., Wm. T. Ingram, Stockton, Calif.

Sept. 18-20—New Castle, Pa. (Castleton Hotel)
Western Pennsylvania Section A.W.W.A. Sec.-Treas., F. P. Johnson, 418 Flannery Bldg., Pittsburgh, Pa.

Sept. 21—Clementon, N. J. (Silver Lake Inn)
New Jersey Sewage Works Association (Annual Outing). In charge of arrangements, Edw. P. Hyland, Sup't. Water & Sewerage, Town Hall, Moorestown, N. J.

Sept. 24-27—New York, N. Y. (Commodore Hotel)
New England Water Works Association. (59th Annual Convention). Secretary, Frank J. Gifford, 613 Statler Bldg., Boston, Mass.

Sept. 25—New York, N. Y. (Commodore Hotel)
New York Section A.W.W.A. Sec'y., R. K. Blanchard, 50 West 50th St., New York City. (Luncheon meeting during the N.E.W.W.A. Convention.)

Sept. 30-Oct. 2—Detroit, Mich. (Book-Cadillac Hotel)
American Public Works Association. Exec. Director, Frank W. Herring, 1313 E. 60th St., Chicago, Ill.

Oct. 1-2—Columbus, Ohio (Neil House)
Ohio Conference on Sewage Treatment. Sec'y., B. M. McDill, State Department of Health, Columbus, Ohio.

Oct. 3-4—Columbus, Ohio (Neil House)
Ohio Conference on Water Purification. Sec'y., T. R. Lathrop, State Dep't. of Health, Columbus, Ohio.

Oct. 3-5—Chicago, Ill. (Hotel Sherman)
First Annual Convention
Federation of Sewage Works Associations
Sponsored by
Central States Sewage Works Association
Gen'l Chairman, George J. Schroepfer, Box 3598, St. Paul, Minn. Local Chairman, Dr. F. W. Mohlman, San. Distr. of Chicago, 910 So. Michigan Blvd., Chicago. Sec'y.-Treas. Central States Ass'n., W. H. Wisely, Ill. State Dept. of Health, Springfield, Ill.

Oct. 4-5—Stafford, Ariz.
Arizona Sewage & Water Works Ass'n. Sec'y.-Treas., F. C. Roberts, Jr., State Board of Health, Phoenix, Ariz.

Oct. 8-11—Detroit, Mich. (Book Cadillac Hotel)
American Public Health Association. Exec. Sec'y., Dr. Reginald M. Atwater, 50 West 50th St., New York City.

Oct. 9—Millinocket, Me.
Maine Water Utilities Association. Sec'y.-Treas., Earle A. Tarr, Winthrop, Me. (Future Meeting—Dec. 12—Mexico.)

Oct. ....—Atlanta, Ga. (Georgia School of Technology)
Georgia Water and Sewage Association. Sec'y., Paul Weir, 1210 Hemphill Ave., Atlanta, Ga. (Dates to be selected.)

Oct. 10-11—Glens Falls, N. Y.
New York Section A.W.W.A. Sec'y.-Treas., R. K. Blanchard, 50 West 50th St., New York City.

Oct. 14-17—TULSA, OKLA. (Mayo Hotel)
Southwest Section A.W.W.A. Secretary, Lewis A. Quigley, 3320 W. Berry Street, Fort Worth, Texas.

Oct. 14-16—MANITOWOC, WISC. (Hotel Manitowoc)
Wisconsin Section A.W.W.A. Sec'y.-Treas., L. A. Smith, City Hall, Madison, Wisc.

Oct. 16-17—SPRINGFIELD, MASS. (Hotel Kimball)
New England Sewage Works Association. Sec'y.-Treas., LeRoy W. VanKleeck, State Dep't. of Health, Hartford, Conn.

Oct. 16-18—ATLANTIC CITY, N. Y. (Haddon Hall)
Pennsylvania Water Works Association. (45th Annual Meeting.) Secretary, F. Herbert Snow, 507 Telegraph Bldg., Harrisburg, Pa.

Oct. 18-19—ATLANTIC CITY, N. J. (Madison Hotel)
New Jersey Section A.W.W.A. Sec.-Treas., C. B. Tygert, Box 178, Newark, N. J.

Oct. 21-23—LEXINGTON, KENTUCKY (Hotel Lafayette)
Kentucky-Tennessee Section A.W.W.A. Sec.-Treas., H. D. Schmidt, State Dept. of Health, Nashville, Tenn.

Oct. 23-26—LOS ANGELES, CALIF. (Los Angeles-Biltmore Hotel)
California Section A.W.W.A. Secretary, Burton S. Grant, 207 So. Broadway, Los Angeles, Calif.

Oct. 24-25—HUNTINGTON, W. VA.
West Virginia Section A.W.W.A. Sec'y.-Treas., J. B. Harrington, Dep't. of Health, Charleston, W. Va.

Oct. 28-30—RALEIGH, N. C. (Sir Walter Raleigh Hotel)
North Carolina Section A.W.W.A. Sec'y.-Treas., R. S. Phillips, 319 E. Trinity Ave., Durham, N. C.

(Meeting jointly with)

North Carolina Sewage Works Association. Sec'y., M. F. Trice, State Board of Health, Raleigh, N. C.

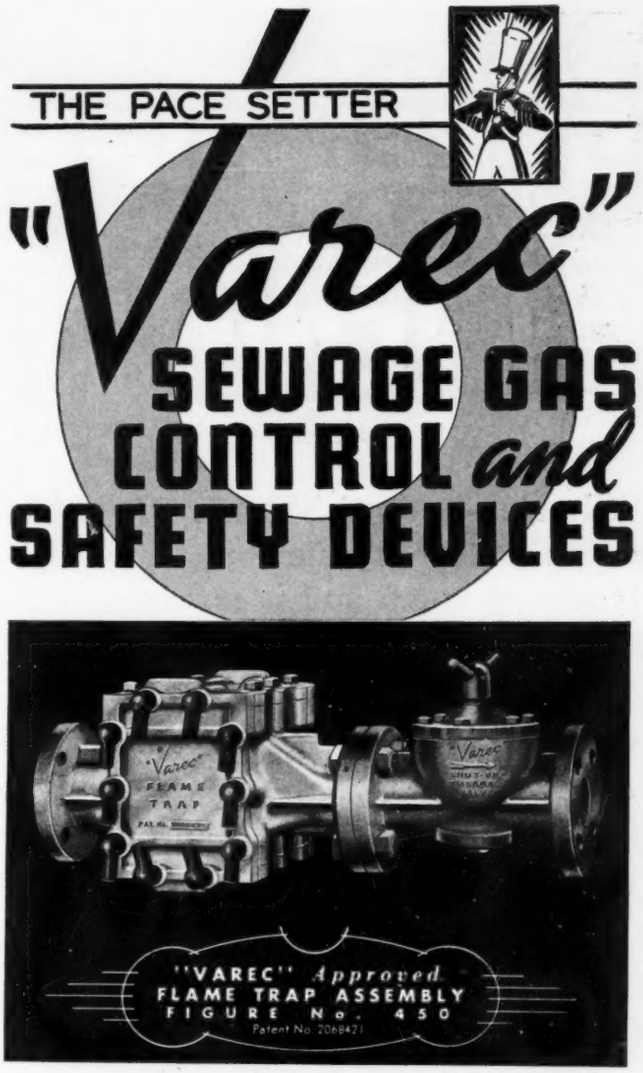
Nov. 7-8—ST. PAUL, MINN. (Hotel St. Paul)
Minnesota Section A.W.W.A. Sec.-Treas., R. M. Finch, W. & T. Co., 416 Flour Exchange, Minneapolis, Minn.

Nov. 7-8—WILMINGTON, DEL. (Hotel Du Pont)
Four States Section A.W.W.A. Sec'y.-Treas., Carl A. Hechmer, Washington Suburban Sanitary Dist., Hyattsville, Md.

Nov. 13-15—OMAHA, NEB. (Fontenelle Hotel)
Missouri Valley Section, A.W.W.A. Sec'y.-Treas., E. L. Waterman, Univ. of Iowa, Iowa City, Ia.

LITERATURE AND CATALOGS

"VAREC Gas Control and Safety Devices" are presented in a new catalog just off the press, from the Vapor Recovery Systems Co. of Compton, Calif. The very attractively bound and effectively assembled catalog contains considerable information and data which for the first time becomes available to designing engineers. Illustrated and described is the "Varec" line of Gas Control and Safety Devices that this company had perfected during a period of years of research and experimental work, and observations of performance of working installations in the oil and gas fields, long before entering the sewage treatment field. This catalog, however, is devoted wholly to sewage gas equipment. There are pictured numerous typical installations of Flame Arrestors and Traps, Pressure Relief Assemblies and Pressure Regulators, Waste Gas Burners, Vacuum Breakers and Relief Valves, Manhole Covers, Check Valves, Manometers, Drip and Sediment Traps, in some of the 300 plants now "Varec" equipped and listed in part. The several "Varec" units are fully covered by specifications, flow capacity graphs, and photographs and sectional drawings. Flow capacity and loss of head curves are shown for each. A typical flow diagram for sludge digestion systems is pictured with the several "Varec" units indicated in positions where each should be considered for maximum safety. For a copy of "Varec" Catalog 3-S, write The Vapor Recovery Systems Co., Compton, California (Main Office), or 30 Church St., New York, N. Y.



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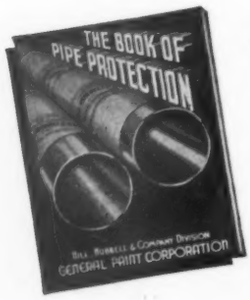

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"NORWOOD's Complete Water Treatment Services" are presented in a thorough and complete manner in a new convenient folder for filing which has come from The Norwood Engineering Co. of Florence, Mass. This folder discloses the background of the company, which has been maunfacturing filters and filtration equipment since 1896, and ozonizers since 1934. Then follows an introduction to the present management and personnel of the Company. Thereafter individual sections are devoted to a presentation of the full and varied line of Norwood equipment—Filters, Underdrain Systems, Control Tables, Mixing Equipment, Valve Controls, Chemical Feeding Equipment, Ozonizers, etc. Included also are "Some things they say about Norwood equipment and service" and an imposing listing of Norwood installations in the U.S.A. and Canada. For one of these filing catalog type loose leaf folders write The Norwood Engineering Co., Florence, Mass.

"Bitumastic Bulletin" is a newcomer amongst house publications to be introduced to our readers. Vol. 1, No. 1, was issued in July by Wailes, Dove-Hermiston Corporation—the purpose of which is "in the interest of corrosion protection." The first issue of "Bitumastic Bulletin" emphasizes the 80 year history of W, D.-H.'s first Bitumastic Enamel and the present line of enamels and paints for hot and cold applications now produced by the company. The "Reporter's Column" names some recent interesting applications. Featured, is the new Dallas Sewage Treatment Plant which has been extensively protected with Bitumastic No. 50, a coal-tar paint for cold application to obtain a film thickness up to 1/16th inch for protecting exposed concrete, floor gratings, screen structures, valves and gates, weirs, pipe lines, vent stacks, etc. If you are not on the "Bitumastic Bulletin" mailing list, write Wailes, Dove-Hermiston Corp., at Westfield, N. J.

"Protective Plant Lighting" is subject of a timely release by General Electric which gives many helpful suggestions and useful pointers on protective lighting for plant and grounds which has recently assumed importance in the National program of defense. Eight sketches depict examples of protective lighting and how to meet basic requirements. For a copy of "Protective Plant Lighting," write General Electric Co., Schenectady, N. Y.

"M.S.A. Hose Masks" are the subject of a new descriptive bulletin from Mine Safety Appliances Co., dealing with the application of the improved M.S.A. All-Vision Facepiece to the Company's well-known line of Hose Masks. These masks, known for their comfort and complete protection, now feature greatly increased lens area of the facepieces. The non-fogging, large-area lenses of laminated shatter-proof glass permit complete vision through all viewing angles. Built-in fogproof construction assures that the incoming air will keep the lenses clear clear of condensation (sweating) at all times. Copies of the latest Hose Mask Bulletin No. EB-4 may be had from Mine Safety Appliances Co., Pittsburgh, Pa.

"Sherwood's Story" is told in a leaflet describing the interesting plastic compound known as "Waterplug" used in stopping trickling, spurting or spraying water leaks, even where under considerable pressure. Also, the products "Quickseal" and "Thoroseal" for waterproofing masonry and concrete walls are mentioned. If interested in this handy material—"Waterplug"—or the liquid sealing materials, write Sherwood Waterproofing Corp., 53 Park Place, New York City.

"Pittsburgh-Nordstrom Sewage Plant Equipment" is presented in a bulletin from Merco-Nordstrom Valve Co. (Subsidiary of Pittsburgh Equitable Meter Co.). The bulletin features Nordstrom Plug Type Self Lubricated Valves, EMCO Gas Meters, and Pittsburgh Meters employed in sewage treatment plants. The illustrations picture plug-valve applications in modern treatment plants—sludge, air and gas lines—and EMCO Gas Meters of large and small capacities; also hot water meters for recirculating heating systems. For a copy of (Bul. 1042) write Merco Nordstrom Valve Co., Pittsburgh, Pa.

A.-C. Single-Stage Blowers are featured in a new illustrated bulletin of 24 pages from Allis-Chalmers Mfg. Co. A.-C. Single-Stage Turbo-Blowers are designed to supply large volumes of air or gas under pressures of from 1 to 6.25 pounds. The bulletin discusses the advantages of turbo-blowers, their method of operation and characteristics. It illustrates and describes various single-stage motor and mechanically driven blowers, including geared-head, over-hung, and pedestal types, as well as double inlet blowers for very large volumes. Many typical applications are pictured and several pages are devoted to blower accessories. For a copy of Bulletin B-6048 write Allis Chalmers Mfg. Co., Milwaukee, Wisc.

"Flexible Couplings by LINK-BELT" are subject of a new 12-page illustrated catalog presenting Link-Belt's complete line of flexible couplings. It contains complete price and dimensional data on three types of couplings, together with information on revolving and stationary casings for one type. The most recent addition to the line—a horizontally-split aluminum casing—is described fully. Simple selection tables and instructions for installation and lubrication add value to the new Catalog No. 1845 which may be had by dropping a postal card to Link-Belt Co., 307 No. Michigan Ave., Chicago, Ill.

"Eight Good Reasons"—tells why ALCO Electric Welded Steel Pipe (without girth seams) in 40-ft. lengths should be used in water supply lines of 30-inch and above, and 22-ft. lengths for smaller diameters. Illustrations picture installation views of Alco pipes in important systems. For a copy write Alco Products Div., American Locomotive Co., 30 Church St., New York City.

Two New Permutit Bulletins covering boiler and process water treatment have been recently received, Bul. No. 2341, devoted to "Hot Process Water Softeners," is comprehensive and deals with methods and softening chemistry as well as equipment and accessories. Bul. No. 2357 is devoted to spray type "Deaerating Heaters," for cutting down corrosion of boilers and piping. The Permutit process is said to remove with completeness all dissolved oxygen and carbon dioxide from the water passing through the deaerators. For either or both bulletins, write The Permutit Co., 330 West 42nd St., New York City.

"Municipal Zeolite Plants—Their Performance"—is the subject of a review of the performance of municipal zeolite softening plants by H. M. Olson, Chemical Engineer with the Ohio Salt Co. The paper reveals the results of a survey made by Mr. Olson of 27 such plants in Ohio and Pennsylvania, including rather complete data on which conclusions are based. A discussion follows by C. P. Hoover and others. For a copy write The Ohio Salt Co., Wadsworth, Ohio.

ENGINEERING DATA IN NEW COMMINUTOR ✦ ✦ BULLETIN ✦ ✦

Simplifies Selection, Setting and Layout

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COMPLETE ENGINEERING INFORMATION:

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Method for Estimating Sewage Flow.

HYDRAULIC CHARTS FOR SEWER DESIGN:

Discharge of Circular Sewers in M.G.D. (Kutter's n = .013 and n = .015)

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This new Comminutor Engineering Bulletin will be off the press in August. Send for our copy now

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MORE THAN 700 COMMINUTORS INSTALLED

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CHICAGO PUMP COMPANY

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AERATORS—COMMINUTORS—SAMPLERS

2349 Wolfram St. Chicago, Ill.

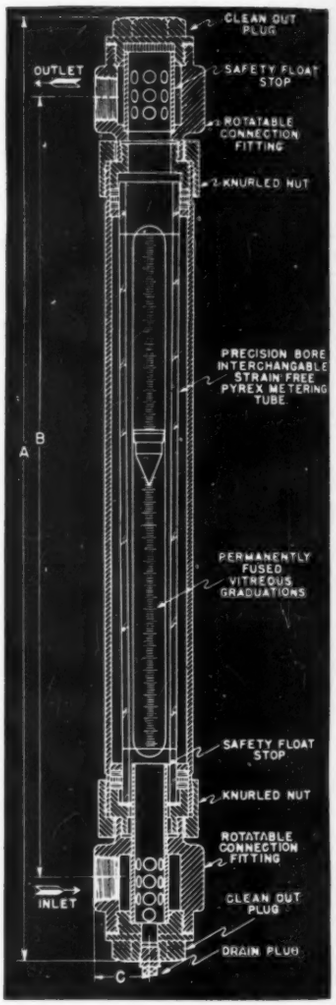
EQUIPMENT NEWS

Improved "Rotameter" by Fischer and Porter

● The "Rotameter" is a device for indicating rates of flow of gases and liquids which dates back to patents granted in 1897. However, the precision instrument of today is another story, as told by Fischer and Porter Co. of Philadelphia in a recent bulletin—"A New Trend in Flow Measurement."

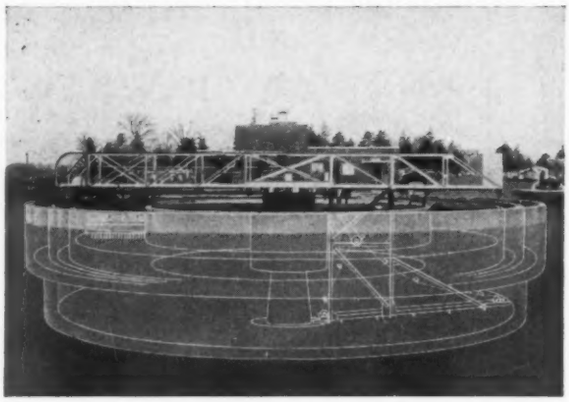
The essential part of the "Rotameter" is a transparent tapered tube, the bore of which increases from bottom to top. The gas or liquid flows upward through the tube buoy a plumb-bob shaped float which continuously spins and maintains an exact center position thereby. As the flow increases the "spinning-top" ascends and reveals the rate of flow by standing at one of the graduation marks, fused into the calibrated transparent tube.

"Rotameters" are being put too many uses in water and sewage plants, such as units for measuring rate of water flow through meters under test; flow control to lime slakers; the dosage rates of alum and ferric salts in solution; for the flow of hot water to digesters; recirculation flow in engine cooling systems; compressed air to aerating units; the feeding of chlorine and other compressed gases.



For a copy of "A New Trend in Flow Measurement," which effectively describes and illustrates the "Rotameter" and its adaptations, write Fischer and Porter Co., 110 W. Penn St. (Germantown), Philadelphia, Pa.

"MUNICIPAL" SAND FILTERS FOR SEWAGE AND TRADE WASTES



1.9 MGD. filter—Somerville, N. J.—for chemically precipitated sewage.

Municipal Sand cleaners are the only filter units that scour the sand and scrub the screen, removing bacterial growth.

Removal of suspended solids by filter 40 to 50%. Filter gives positive control of suspended solids in effluent and sedimentation period can be safely cut down, thereby greatly reducing cost of settling tanks.

In one revolution of the sand cleaner 86% of the trapped solids are removed from the sand. Unless all solids trapped in the sand are removed bacterial growth on sand and screen soon plug the filter.

Installations at:

South River, N. J. — **Rutherford, N. J.**
Somerville, N. J. — **Sayreville, N. J.**
Raritan, N. J.

MULTI-ZONE FURNACES for incineration of sewage sludge, screenings and ground garbage
and
DRYERS—for sewage sludge and industrial products
Are other products of

UNDERPINNING & FOUNDATION CO., Inc.
155 East 44th St. — New York, N. Y.

Automatic Reset Timer

● The new Cramer RS Automatic Timer is a very compact instrument for automatic accurate timing of a variety of electrical circuits.

The timer consists essentially of an enclosed snap action switch unit which is actuated by an operating arm driven in one direction by a small synchronous motor, with an enclosed magnetically operated gear clutch. A spring resetting means returns the timer to the starting position after the time cycle has been completed.

Time settings are easily adjusted by setting the pointer to the desired time scale. Several time ranges are available to meet various timing requirements. The contact has a capacity of 10 amperes at 115 volts or 5 amperes at 230 volts. The instrument can be furnished for flush panel mounting or in a dustproof die cast case suited for BX or conduit wiring.

Further information on the new "RS" Automatic Reset Timer can be obtained by writing the manufacturer who, incidentally, produces a very complete line of timing and sequence control units. Address, The R. W. Cramer Co., Inc., Centerbrook, Conn.

New Electric Etcher

● A new and modern portable "Universal" Electric Etcher, for marking tools, etc., has just been announced by the Ideal Commutator Co. The etcher tool and cords, switch and indicator lamp are all in a compact case.

Etching heats obtainable are 120, 240, 420 and 700 watts—a red indicator lamp burns brighter as the hotter heats are turned on. Writing with the fine pointed tool is as easy as with a pencil yet the marking is clearly and permanently burned into the metal. The standard unit is for 110 volt, 60 cycle, A. C. current, other voltages and frequencies being available upon specification.

For a descriptive leaflet write Ideal Commutator Co., 1615 Park Ave., Sycamore, Ill.

Has Your City Money to Burn?

Royer "Jr."—one of twelve models—eliminates incineration costs and makes profits instead for a Wisconsin city.

No city has money to burn *today*—yet when you incinerate, bury or dump sewage sludge, it's like burning money because dried sewage sludge has a real cash value when properly prepared for marketing as fertilizer with a Royer Sewage Sludge Disintegrator.

Wide awake operators of sewage treatment plants in many states are realizing a worthwhile profit from the sale of sludge that formerly cost them many dollars to dispose of.

The Royer shreds, mixes and aerates sludge with a moisture content as high as 51%, further drying it, and discharges the finely shredded product into trucks or wagons. It thoroughly mixes in lime, ammonium sulphate or other enriching materials which further increase the market value of the sludge.

There's a market for your sludge within an hour's drive of your plant—all you can produce. Get the complete facts on what other plants are doing, how to capitalize on a brand name and *new* bulletin showing 12 models, from $250.00 up; gas engine, electric motor and belt-to-tractor driven.

ROYER FOUNDRY & MACHINE COMPANY

170 Pringle Street, Kingston, Pa.

THE ROYER

IF Your Sewage effluents are high in suspended solids;

Or, you have a Water Problem;

Or, desire to Recover a product now wasted;

Or, you are disturbed by Stream Pollution;

Or, are in any way interested in the removal of suspended solids from liquors;

You should investigate the

Laughlin Modified Rapid Sand Filter

BECAUSE, it is a simple automatic, continuous flow apparatus, designed on familiar lines, to accomplish a purpose without adding to the operator's troubles.

LAUGHLIN EQUIPMENT CORPORATION

270 Madison Ave., New York City

HYDRO-TITE

ONE POUND does the work of four pounds of lead. Much easier to use than lead and requires no caulking.

HYDRO-TITE joints are strong, very flexible and tight.

Write for our free trial offer.

HYDRAULIC DEVELOPMENT CORPORATION

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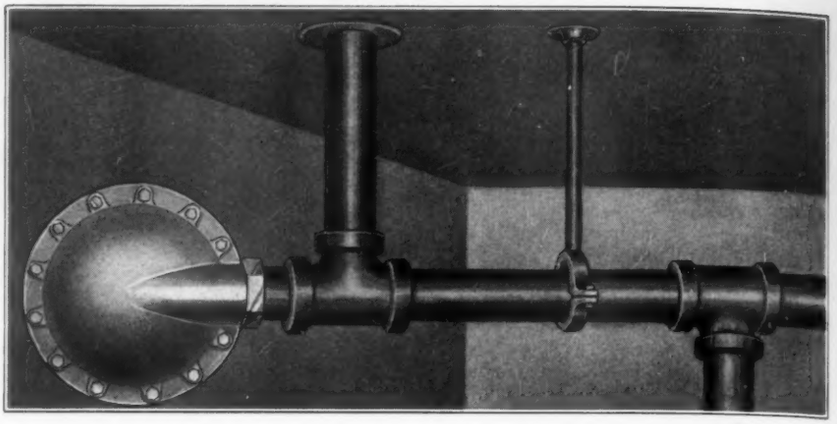
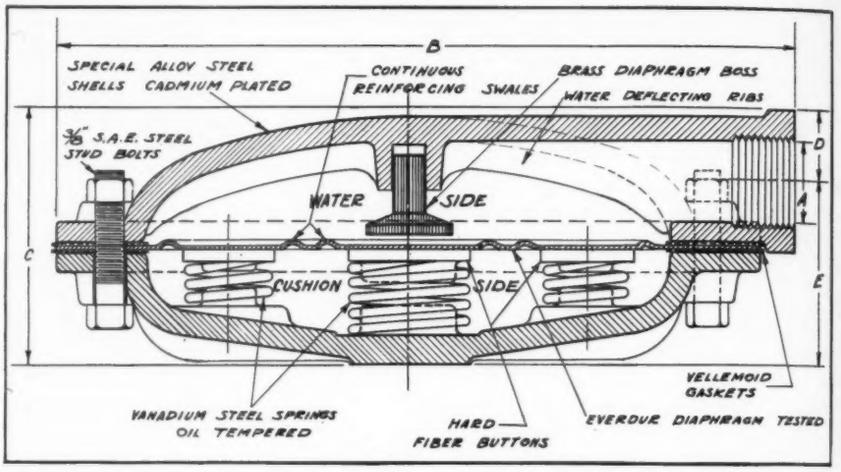
GENERAL OFFICES AND WORKS - WEST MEDFORD STATION BOSTON, MASS.

OVER 25 YEARS WITHOUT A FAILURE

Shock Absorbers for Cushioning Water Hammer





● Joseph Shock Absorbers may not be new, but to most readers of this magazine they will be. The unit as pictured above consists essentially of a spring loaded diaphragm of corrosion resistant "Everdur" bronze, which serves as a "bumper" for water surge. More explicitly the four vanadium steel resilient springs serve to dampen out the high pressure waves of water hammer by "knee-action" such as is employed in smoothing the bumps in automobile springing.

Action of the Josam Shock Absorber is explained by the manufacturer as follows: "On striking the walls of the chamber, the density waves of water hammer bound and rebound between the chamber walls and the flexible diaphragm. In turn. the vibration of the diaphragm so changes the impact and rebound angles of these waves that they diffuse into each other at irregular intervals and in all directions." The dampening effect thus secured prevents the usual reflex wave which passes backward and forward in pipe lines, in accord with the laws governing wave action and hydraulic ram effects, to make water hammer noise and damage piping and equipment. Although Josam Absorbers are manufactured in sizes up to 2 inch only, for larger pipe lines more than one may be employed with the same results.

For a descriptive folder showing recommended locations on troublesome lines and giving a more detailed description of the Josam Shock Absorber, write Josam Mfg. Co., Empire Bldg., Cleveland, Ohio.

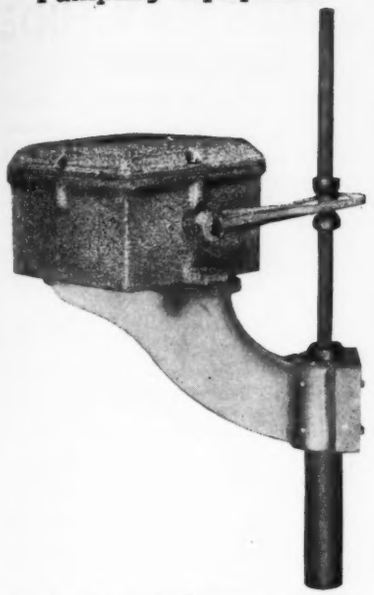
Chrome-Armored Water-Lubricated Pump Bearing Developed

● By heavy application of electrolytically-deposited chromium over a monel stainless sleeve which has been swedged into a vertical pump shaft, a new type of water-lubricated bearing has been produced by Peerless Pump Co. of Los Angeles.

The process has been perfected for use in deep well vertical pumps. The pump shaft is armored with heavy chromium over a non-corrosive metal sleeve every ten feet. These sections of the shaft operate within resilient cutless rubber journals, which are fluted and are non-revolvable. Any sand in the water flushes through the bearing. Heretofore the use of a chrome surface was not satisfactory, due to its microscopic porosity, its thin wall and its eventual disruption from the carbon steel to which it was usually bonded. By the new Peerless process the chromium is electrolytically deposited on monel to a thickness which is more than fifty times that of ordinary automotive chromium plating. In pumps placed under accelerated life tests, pumping water heavily laden with sand, the results indicate a shaft life of twenty-seven times that of an ordinary carbon steel shaft.

A bulletin describing this new chromium-armored bearing may be obtained by writing to Peerless Pump Company, 301 W. Avenue 26, Los Angeles.

New Alternator for Duplex Pumping Equipment



● Barclay Control Company of Chicago has just announced an Automatic Alternator for duplex pumping equipment.

Known as the Barclay Automatic Transfer Switch, this new device provides a simple and positive means of alternating the sequence of pump motor operations. A further measure of automatic control is provided by this device, since it will automatically cut in idle pumps under flood conditions, or in the event one pump goes out of service the other is cut in (automatically) to do double duty alone.

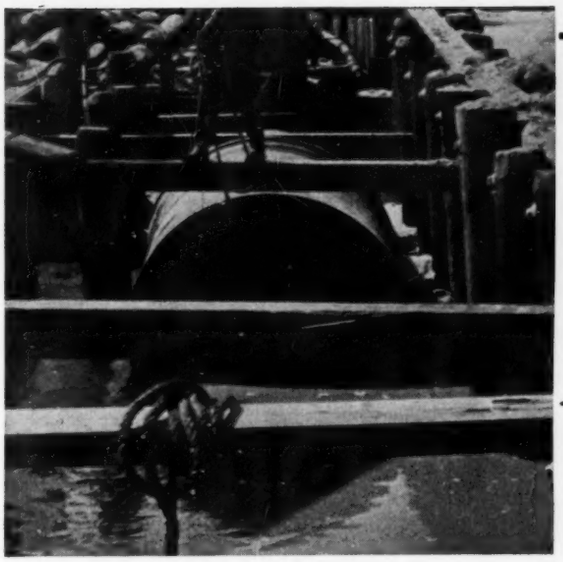
The outfit consists of a fully housed controller unit with slotted operating lever. This lever is constructed to take all sizes of float rods and cables, so the device is as readily applied to existing installations as to new equipment. It operates equally well on alternating or direct current. Installation and wiring are said to be as simple as installing a push button station. Its adaptation eliminates the need for additional float switches; also, an extra rod and float. The unit is mounted in a weatherproof, cast aluminum housing, and all internal parts are rust-proof, being made of aluminum, brass and bronze, cadmium plated.

A new bulletin giving full details of the Barclay Automatic Transfer Switch may be obtained by writing Barclay Control Co., 5152 Division Street, Chicago.

Permanent Protection for Papers and Documents

● There is now available a method for securing permanent all-time preservation and protection of valuable papers, documents, maps, records, clippings, photographs, etc. In this process the sheet is protected by applying an enveloping film similar to "cellophane" or "pliofilm." Thus a protective and soil-less film of preserving transparency is secured.

The Transparent Protection Company of New York will supply samples of such work, and they also offer to do a specimen job without charge. For further information and a sample of the work, address this company at 62 West 45th St., New York, N. Y.



84" pipe—Spring Lake, N. J.

FLANGED PIPE
FLEXIBLE JOINT PIPE
BELL & SPIGOT PIPE
SPECIAL CASTINGS
SHORT BODY BELL & SPIGOT SPECIALS

Large stock enables us to make prompt shipments.

CAST IRON PIPE

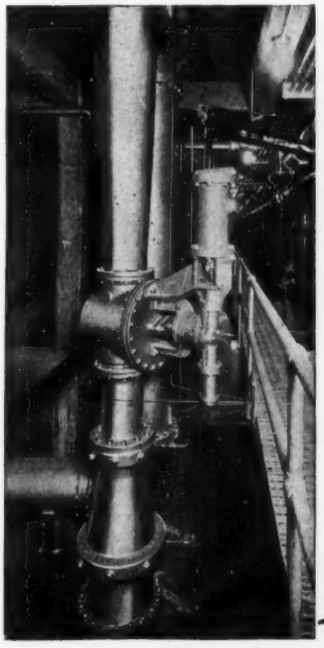
SIZES 2" TO 84"

Warren Foundry & Pipe Corp.
11 Broadway, New York

Warren Pipe Company of Mass., Inc.
75 Federal St., Boston

Which Primary Element?

VENTURI TUBE, FLUME, WEIR, ORIFICE, OR NOZZLE



The primary element for your metering application should be selected not arbitrarily but by the requirements to be fulfilled and by the economic considerations entering into the installation.

Sewage and sludge are often, though not always, measured by Venturi Tubes, Flumes, or Weirs.

Water may be satisfactorily measured by any type of primary element. Factors such as the cost of pumping, the pressure and the size of pipe or channel usually dictate the device used.

Steam is usually measured by the Bailey Orifice or Flow Nozzle.

Bailey Meter Company holds no brief for any particular primary element, its only interest is in making sure that the user secures the highest accuracy and reliability at the lowest expense.

Detailed information on the advantages of various types of primary elements furnished on request.

MU-18

BAILEY METER COMPANY
1072 IVANHOE RD., CLEVELAND, O.
Bailey Meter Company Limited, Montreal, Canada

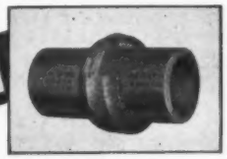
BUY DIRECT!

FULLERS EARTH
Filters — Bleaches — Clarifies
Your Lubricating Oils

FILTER SAND
The Correct Grade—CL or LcL

SILICA QUARTZ NATURAL GRAVEL
Meets water Works Specifications

TAMMS SILICA CO.
228 N. LaSalle St. Chicago, Ill.
MILLS—OHIO and ILLINOIS



GASKET AND FORM
The Perfected Method for Making
SEWER PIPE JOINTS OF CEMENT

- No jute used—gasket centers spigot.
- Definite space in each joint for cement.
- Form confines cement-grout to lower portion of joint.
- Particularly advantageous in water-bearing trenches.
- Infiltration minimized.

L. A. WESTON Adams, Mass.

EDSON'S NEW HAND PUMP

Smallest Diaphragm Pump Made, 2" Suction Open Discharge. Capacity 1400 G.P.H. Weight 50 lbs.

THE EDSON CORP'N
49 "D" Street
So. Boston, Mass.
NEW YORK: 142 Ashland Pl., Brooklyn
CHICAGO: 1061 Peoples Gas Building

Catalog "T" Gives Full Data, Also Edson Hand and Power Pumps, Suction Hose and Pump Accessories

When you think of
ALUM
... think of
ACTIVATED

ACTIVATED ALUM CORPORATION
Curtis Bay Baltimore, Maryland

New "F-M" Vertical Single Phase Motors

Fairbanks-Morse has recently announced a line of integral horsepower vertical single phase motors, in sizes from ¾ to 5 hp. These motors. because of their combination of electrical and mechanical characteristics, are unusually adaptable to operate in isolated localities where small pumping units are so often located.

Dripping or splashing water will not harm these motors under normal operating conditions, since the design prevents water from reaching vital parts. And, a highly desirable characteristic is the exceptional quietness with which the motors operate, even at speeds of 3600 r.p.m. Solid or hollow shaft modifications are available. The solid shaft units are usually direct-connected to a pump or machine through a flexible coupling. The hollow shaft unit is particularly well adapted to vertical pump applications because of the advantages of compactness, permanent shaft alignment, and high thrust capacity. This type of construction provides an easy and convenient method of installation, since the pump shaft extends up through the motor shaft. The pump shaft is held in place by adjustable lock nuts above the upper motor bearing. The latter is designed to support the entire thrust load including weight of the shaft, rotating parts of the pump and the water column load.

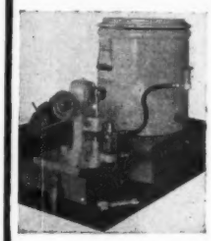
Operating speeds are 1200, 1800 and 3600 r.p.m. All 1800 r.p.m. and lower speed motors are built in the repulsion-start induction-run type. As the name implies they start as a repulsion motor. with each two pairs of brushes short circuited, and at a predetermined speed a centrifugal device short circuits the entire commutator allowing the motor to come up to speed and operate thereafter as an induction motor. The 3600 r.p.m. ratings start as a repulsion motor and, as the speed rises, the deeply imbedded squirrel-cage winding in the rotor picks up a large portion of the load automatically in much the same manner as does the inner winding of a double-squirrel-cage rotor in a polyphase motor.

For Bul. No. 2450 describing these new F-M motors, write Fairbanks-Morse & Company, 600 South Michigan Ave., Chicago.

Prevent wear and cutting of rods, plungers, shafts and valve stems by using
MABBS RAWHIDE PACKING
In Your Water Works and Sewage Plants
IT LASTS LONGER — *Is Anti-Frictional, Saves Power, Labor and Repairs. Will prove the cheapest packing that can be bought.*

Trade Mark Reg. U. S. Pat. Off.
Mabbs Hydraulic Packing Co.
Incorporated 1892
431 S. Dearborn St., Chicago, U. S. A.

WILSON CHEMICAL FEEDER



Outstanding features are quick feed adjustment, visible valves, flexible cylinders; feeds against 150-lb. pressure, and proof against corrosive chemicals.

Motor driven, positive displacement, pump type feeder. It is illustrated as a constant rate feeder though also furnished as Type MD-H with fluid meter control, and when so arranged is a measure-to-measure proportioning feeder.
This is a sturdy, dependable heavy duty feeder.

Write for Bulletin
Wilson Chemical Feeders, Inc.
BUFFALO, NEW YORK

The Meter-Master
RATE RECORDER FOR WATER METERS
Send For Literature
F. S. BRAINARD & CO.
246 Palm Street, Hartford, Conn.

EXCEPTIONAL BACKFILLER VALUE
This P&H Backfiller with 30-ft. boom and 4-ft. scraper bucket. Arranged as field loader. Waukesha 4-cyl. engine develops 37 h.p. Located Picayune, Miss. Cash or terms. Write Box No. 80, Water Works & Sewerage, 330 So. Wells St., Chicago, Ill.

Position Wanted — Graduate Sanitary Engineer, 3 years experience in taste and odor control, filter plant operation, sanitary chemistry, and sewage plant design and operation, wishes to secure position in operation, laboratory, construction, or design phases of Sanitary Engineering. Address Box K, Water Works and Sewerage, 155 E. 44th St., New York City.

Simple CO_2 Indicator for Digester or Stack Gas Testing

● Bacharach's inexpensive, compact and easily manipulated CO_2 Indicator strikes us as being probably of considerable interest to water works and sewerage operators—particularly the latter, for reasons to follow.

The Bacharach CO_2 Indicator here pictured is approximately 8 inches in overall height. With it comes rubber tube and aspirator bulb for pumping into the Indicator the gas sample. A dozen strokes of the bulb purges and fills the gas chamber and center glass tube of the unit. The hose is then detached; and, by inverting the instrument a few times as one would an hour-glass, the CO_2 absorbing liquid passing up and down through the tube absorbs this gas completely. The vacuum created

thereby draws the absorbing liquid up into the tube and the elevation therein is so calibrated as to indicate the % of carbon-dioxide in the gas. After a hundred or more tests the absorbing liquid must be replaced, the sudden apparent drop in CO_2 content indicating exhaustion of the absorbent.

The entire test requires less than two minutes to perform and is not subject to errors of manipulation. On this score it serves as an excellent routine test, or control instrument, in the hands of unskilled operators when desired.

Whereas the Bacharach CO_2 Indicator was designed for checking combustion efficiency of furnaces and engines, by making gas testing so simple it has to our mind a distinctive possibility in sewage works operation. For instance there is no better index as to the way sludge digesters are going than a gas analysis for CO_2 or CH_4 (methane) content, and CO_2 is the important indicator of approaching acid digestion long before such is indicated in pH tests applied to the liquor. Therefore, if simple, inexpensive, non-time consuming routine records of the CO_2 trend in digester gas can be maintained effective control of digestion can be had in a "stitch in time" manner long before digestion troubles descend on the operating force. It is also well to consider that a gas sample is a fair sample of the complete contents of a digester, whereas a sludge, liquor or scum sample is at best like taking one scoop of coal from a car load and expecting it to be an average sample.

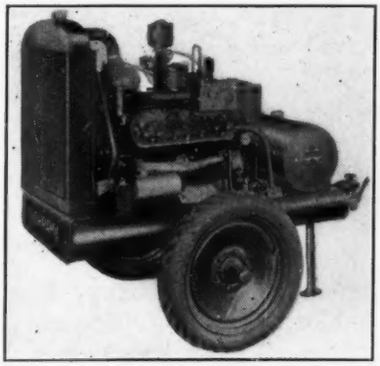
We would recommend that the reader look further into the value of the CO_2 Indicator for stack, engine exhaust and digester gas testing. For a descriptive folder (Bul. 337) revealing the moderate price, write Bacharach Industrial Instrument Co., 7000 Bennett St., Pittsburgh, Pa.

Low Cost "Fordair" Utility Compressor

● Incorporating all of the features of the "big-brother" "Fordair" Compressors, employing four cylinders of the Ford V-8 motor as power cylinders and the other four as compressor cylinders, Schramm, Inc. now announces the "little brother" of the line—"Fordair" Model 40 at a most attractive price.

Model 40 comes mounted on two pneumatic wheels, or on a skid mounting. With a capacity of 40 cu.ft. of air per minute at 100 lbs. pressure this little compressor (57" length x 24" width) weighing 975 lbs. gives a lot of air at low cost. It has ample capacity for most jobs, such as operating air tools, paving breakers, paint spraying, etc.

The manufacturers state that compact design (the compressed air tank serving as the frame) has made it possible to cut the initial cost down to about half that of



compressors of equivalent capacity. And, with 96% of the wearing parts available at any authorized Ford agency, the service and upkeep costs can be guaranteed to be the lowest in the portable compressor field.

For descriptive Bul. No. 4015-3 and prices, write Schramm, Inc., West Chester, Pa.

To SAVE TIME
use this QUICK-ACTION JOINTING COMPOUND

In jointing Bell and Spigot Main you can save days by using *Tegul*-MINERALEAD • With this sulphur-base compound you should meet *at once* any reasonable specification as to leakage • This means you can go right ahead with back-filling and tidying up, cutting risk of traffic accidents • *Tegul*-MINERALEAD makes permanently tight joints with ample flexibility and away-above-average resistance to thermal and mechanical shock • Comes in 10 lb. Ingots, convenient to handle, ship and store, impervious to rain and flood and proof against jolting in transit that might change composition of compounds in other than this solid form • Write for more information. The ATLAS MINERAL Products Company of Penna., Mertztown, Pennsylvania.

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Bennett Heads New Division: Fearon Directs Flow Meter Sales

● Wm. C. Bennett has been made Manager of Cochrane's newly created Appliance Sales Division.

John E. Fearon has been placed in charge of the Flow Meter Sales Section to coordinate sales and engineering, initiate a program of new product development, and assist Mr. Bennett in promoting meter sales.

This announcement came from H. E. Gibson. Vice Pres. and Gen'l. Sales Mgr. for Cochrane Corp.

Fred Hartmann Elected a Director of National Meter

● Fred W. Hartmann, Manager of National Meter Co.'s Chicago office, has been elected a director of the company.

After Mr. Hartmann graduated from the University of Michigan he served as City Engineer and Water Superintendent at Iron Mountain, Mich., and as City Manager at Alma, Mich., before joining the National Meter staff in 1928. He is a trustee of the Illinois Section of A.W.W.A.

Notification of Mr. Hartmann's election came from N. J. Kenney, President of National Meter Co.

Universal Gear Makes Dahlstrand Directory of Sales and Engineering Robbins Becomes Eastern Sales Manager

● Universal Gear Corporation of Indianapolis announces that J. Y. Dahlstrand has been appointed Director of Sales and Engineering for the corporation. He moves to this position from that of Chief Engineer of the corporation, prior to which he was associated with Westinghouse and Allis Chalmers Co. in engineering and sales capacities.

At the same time comes the announcement that E. M. Robbins, Manager of the New York District Office, has been made Ass't. Director of Sales, in charge of all Eastern sales districts of the corporation.

These announcements were made by Geo. E. Palmer, Exec. Vice-Pres. and Gen'l. Mgr. of Universal Gear Corp.

Reading-Pratt & Cady Move Gen'l Sales Office to Reading

● In a recent notice American Chain and Cable Co., Inc., announce that the General Sales Office of the Reading Pratt and Cady Division has been moved from Bridgeport, Conn., to Reading, Pa.

This move is made for the purpose of improving service by bringing about a closer and continuous contact between Production, Engineering and Sales Departments. Inquiries and orders for brass and iron valves will, however, continue to be serviced from the Reading-Pratt & Cady plant located in Hartford, Conn.

Government Purchase Guide (Tells Who Purchases What in Army and Navy)

● The Department of Commerce has just prepared a very helpful Purchase Guide to serve manufacturers who have materials and equipment to sell the Army and Navy.

In this directory are listed the locations (addresses) of the major field purchasing officers of the Army and Navy—27 being listed for the Navy and 46 for the Army. For each office is listed the general types of materials which each field office is currently purchasing, or soon may be.

Bruce Berckmans, Assistant Director of the Bureau of Foreign and Domestic Commerce in an accompanying letter states that the list has been prepared to assist purveyors of equipment and materials in going *direct* to the proper procurement office rather than waste time, money and effort in writing or visiting Washington.

A copy of these lists, with directions as to how best to proceed, can be had from the Bureau of Foreign and Domestic Commerce, Washington, D. C.

Filter Materials Available From Tamms Silica Co.

● Tamms Silica Co. of Chicago announce that they are now in position to supply filter-sand which will pass all water works specifications. In addition they are offering a high grade quartz gravel for filters. And a third item is a Fullers Earth that is especially selected for its value in clarification and filtration. These filtering materials can now be purchased in any required size or shipment from either the Ohio or Illinois mills. For further information, specifications, etc., write Tamms Silica Co., 228 No. LaSalle St., Chicago, Illinois.

J. P. Russell Joins Canadian Engineer Publications

● J. P. Russell, for several years Editor of "Engineering and Contract Record" (Hugh C. MacLean Publications, Ltd.), has resigned in order to join the staff of The Canadian Engineer Publications of Toronto.

Mr. Russell, a graduate in Civil Engineering from the University of Toronto, has had 21 years experience in editorial work which he now takes with him to his new work on The Canadian Engineer Publications, "Roads and Bridges" and "Water and Sewage".

This announcement came from A. E. Jennings, General Manager of The Canadian Engineer Publications. (It is our understanding that Mr. Russell's appointment in no wise affects the status of J. B. Baty, as Editor-in-Chief of "Water and Sewage".—Ed.)

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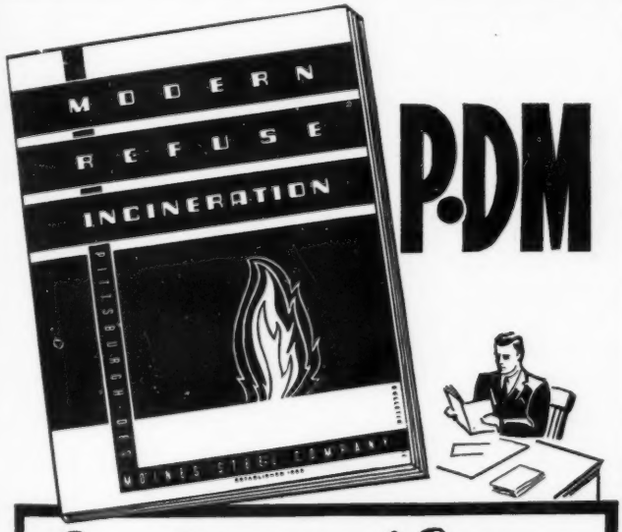

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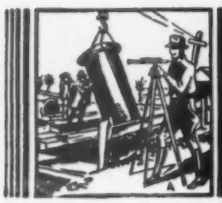

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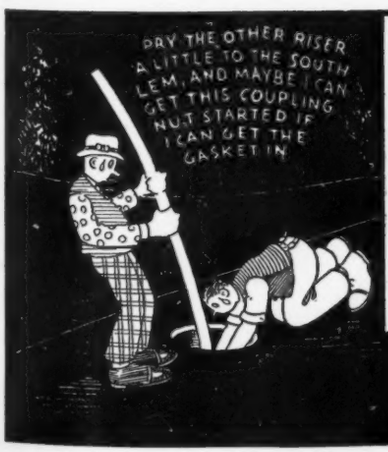

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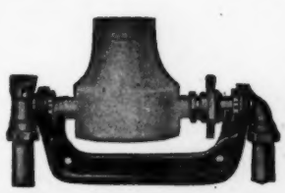

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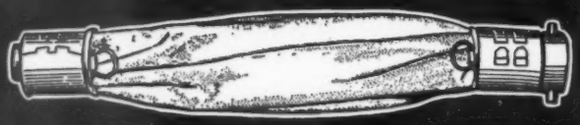

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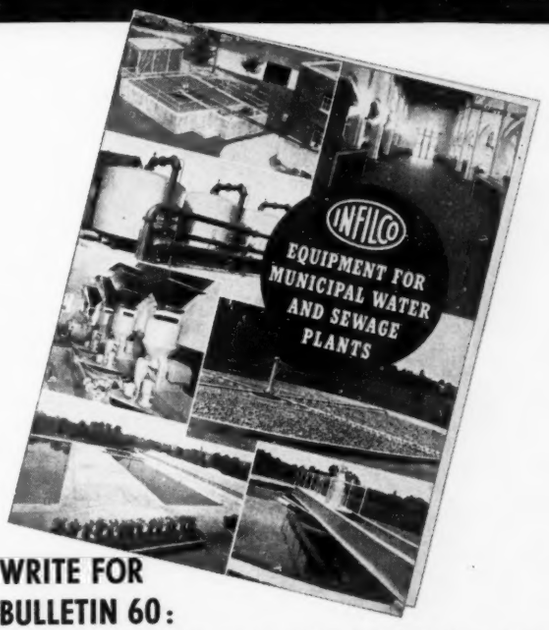

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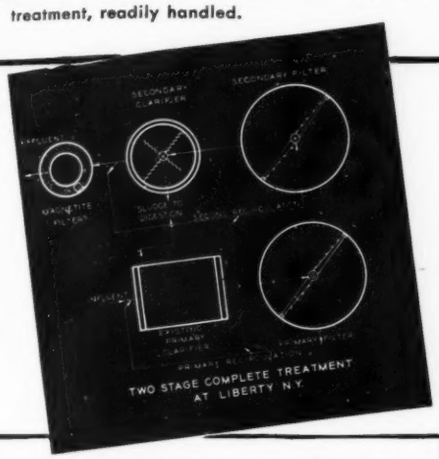
- Expert supervision not required.
- Industrial wastes, not amenable to activated sludge treatment, readily handled.

Liberty during construction:
Bio-filters in foreground, secondary Dorr Clarifier in rear



The first Biofiltration Plant in the East, at Liberty, N. Y., comprises complete primary and secondary treatment, digesters and an Automatic Magnetite Filter for a design flow of 1½ M. G. D. Total installed costs* are unusually low—$92,000 per M. G. D. Anticipated B. O. D. removals are unusually high—423 PPM in influent to 14 PPM in effluent—a reduction of 96.7 percent.

The Biofiltration System, marketed by the Dorr Company, comprises a combination of a Clarifier and a Filter, wherein the filter discharge is recycled back to the Clarifier. Single or Multiple Stage Systems may be employed to give results comparable with (a) Chemical Precipitation (b) Standard Trickling Filter practice or (c) Activated Sludge Process.

This System makes it possible for the first time to control completely the Trickling Filter—to obtain a uniform final effluent despite wide feed fluctuations—to permit up to 10 times normal filter loadings on beds as shallow as 3 ft.

Check the advantages cited above and the data from Petaluma, Cal. Then plan definitely to visit the Liberty, N. Y. installation in September to see for yourself.

*Cost, exclusive of digesters, is $58,000 against $90,000 for standard trickling filters and $50,000 for activated sludge.

Two-Stage Biofiltration at Petaluma, Cal.

Test No.	1	2
Flow—M.G.D.	.503	.500
Dosing Rate Raw—M.G.A.D.	5.05	10.6
Total—M.G.A.D.	17.2	37.1
Sus. Solids—PPM		
Raw	424	462
Final	33	43
Removal—percent	92.3	90.7
B.O.D.'s—PPM		
Raw	576	521
Final	14	28
Removal—percent	97.6	94.6
Raw B.O.D. Loading		
Lbs/cu yd/day	2.47	4.78

Each test represents a week's average results.
Analyses run daily on 24 composited hourly samples.
In test 2, the dosing rate was increased by blanking off a portion of the filter beds.

● *In the meantime write for complete technical report on Biofiltration with operating data, alternative flowsheets, illustrations and cost comparisons.*

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